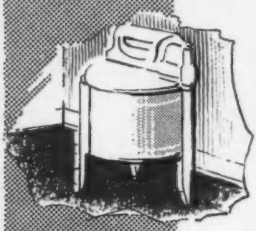
THE MONTHLY

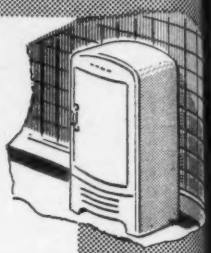
Review

Official Organ of the American Electroplaters' Society
A Society for the Advancement of the Science of Electroplating

JUNE • • • 1946

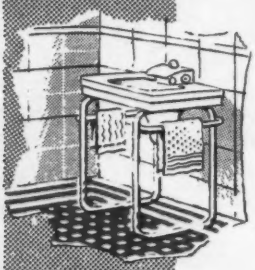
CLEANING PRIOR TO PORCELAIN ENAMELING

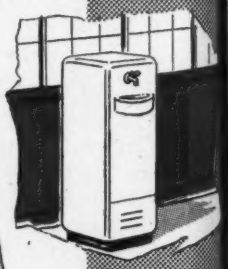


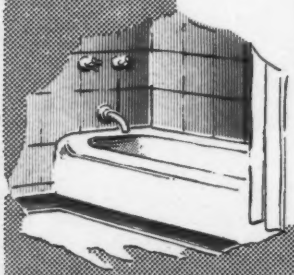


Production tests have shown that porcelain enamel rejects are reduced by using Clepo 26-E in the cleaning operation. The reason for these good results is that Clepo 26-E is very free rinsing and therefore does not interfere with the adherence of the nickel dip. Also Clepo 26-E has extremely high oil penetrating qualities so that even the most stubborn oils are completely removed in a one-minute cleaning time. Clepo 26-E is buffered so that the oil removed is kept in suspension and does not float on top of the solution.

If you would like to make arrangements for a production test in your plant right now, contact us as quickly as possible. The improved results obtained by using Clepo 26-E will amaze you.







Memo to Plant Engineer:

To Reduce Porcelain Enamel Rejects Specify Clepo 26-E for Cleaning prior to Nickel Dipping

FREDERICK **GUMM** *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N. J.

Successful Surface Preparation of ZINC BASE Die Castings Easily Accomplished with Oakite Composition No. 90

Still Tank Method Gives Chemically Clean Surface Before Iriditing, Bonderizing or Blackening Process

BECAUSE of its balanced combination of wetting, penetrating and emulsifying properties, plus the advantage of its excellent free-rinsing characteristics, Oakite Composition No. 90 is providing a successful answer to the problem of preparing zinc base die castings for the satisfactory application of Iriditing, Bonderizing, Blackening and similar commercial processes.

No involved procedures are required in using the Oakite technique for this work. Immersion of zinc castings for approximately 2 minutes in solution of Oakite Composition No. 90 at 212° F. removes contaminating deposits of shop dirt, oil, buffing compounds. No current is used. Operations following are those normally employed applying subsequent finishes. Any plant or shop interested in this economical, quick method of cleaning zinc base die casting is invited to write for further details. There is no obligation. All inquiries promptly answered.

OAKITE PRODUCTS, INC., 40 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized* **CLEANING**

MATERIALS · METHODS · SERVICE · FOR EVERY CLEANING REQUIREMENT

NO OTHER PROCESS OFFERS
ALL THESE ADVANTAGES FOR
FASTER COPPER PLATING!

DU PONT HIGH SPEED COPPER PLATING PROCESS

DU PONT HIGH SPEED COPPER PLATING PROCESS

THIS is the process for speedy, economical, smooth copper plating. Every day, in the many plants using this process, a total of about 500,000 intricately shaped die castings are given a jewelry-like finish—ready for direct plating of bright nickel and chromium.

Here's what this process offers:

1. SPEEDY PLATING—at any given amperage, copper deposits *twice as fast* from the Du Pont monovalent solution as from the usual bivalent solution. Standard reference books show the following rates of deposition:

Copper (cuprous)-2.371g/amp./hr. • Copper (cupric) 1.186g/amp./hr.

2. SMOOTH BRIGHT DEPOSITS—uniform dense plate of commercial thickness can be obtained in a few minutes on steel and die castings.

3. LOW OPERATING COSTS—replenishment costs where suitable equipment is used may be unusually low; only from 5 to 10 lb. of potassium cyanide or sodium cyanide per 5,000 gallons of solution per day!

4. HIGH THROWING POWER—superior throwing power of the cyanide solutions is a typical characteristic of this process.

5. NO VENTILATION PROBLEM—Potassium and Sodium High Speed, Copper Baths do not evolve poisonous or objectionable fumes.

FREE OPERATING MANUAL! Send *your* copy of "Potassium High Speed Copper Plating Process (RH-661)." Contains valuable information for copper platers.

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Electrochemicals Department
Wilmington 98, Delaware

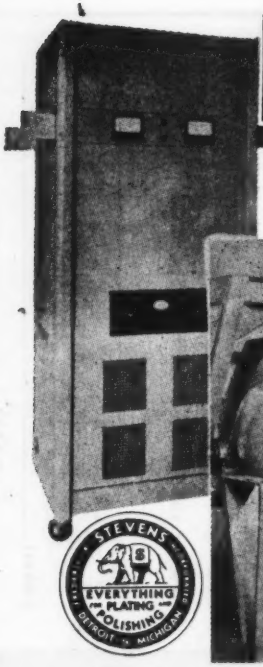
Please send manual for High Speed Copper Plating.

Name_____

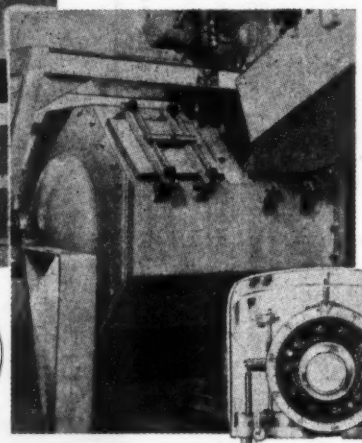
Firm_____ Title_____

Address_____

DEPENDABLE EQUIPMENT



GREEN SELECTRO-PLATERS—in a wide range of capacities—25 to 4000 amperes—all in one cabinet. Most of those capacities can be furnished in several types. (1) Standard (with meters and controls); (2) Basic (without meters and controls), (3) Remote Control (with separate remote controls and meters).



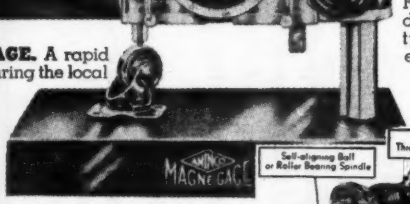
Other variations may be engineered to adapt Selectro-Platers to special requirements. Write for special folder on Selectro-Platers, Multiplaters and the Heavy Current Group

ROTO-FINISH EQUIPMENT. The amazing Roto-Finish Process gets better and better. The new, vastly improved machine, as a war production development, has rapidly proved its value for peace-time operations.

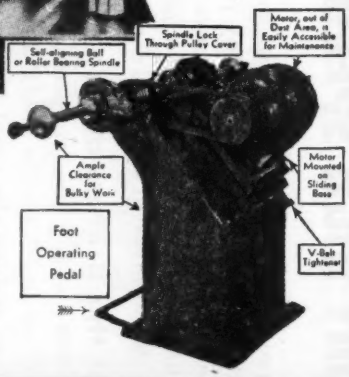
This unusual new process . . . which works equally well on steel, brass, aluminum, magnesium, stainless and nickel steel—will be a "NATURAL" for lower costs in peace-time competition.

Send for our Roto-Finish Folder which completely describes the various types of this modern equipment.

AMINCO-BRENNER MAGNA-GAGE. A rapid and non-destructive method of measuring the local thickness of coatings on metals. Measurements are made in a fraction of the time required by other methods. It eliminates costly rejections as it quickly reveals whether or not the thickness of plating conforms to specifications. For works control or acceptance testing, Magna-Gage gives profitable results. Investigate it! We are distributors for Michigan, Ohio, Indiana, and the Buffalo, N. Y. territory. Write for Bulletin 2125.



STEVENS SAFETY LATHE. When the operator's hands are busy—the Lathe may be stopped instantly by slight pressure on the foot brake. This machine gives the latest developments in operator's protection. Regardless of how the operator's hands are engaged—holding a bulky piece of work, applying composition to the wheel, or, if his sleeve or apron gets caught on the wheel or shaft, that slight foot pressure on the brake stops the machine instantly. It eliminates many painful injuries, with the resulting loss of production time. Send for complete information on this, and other Mitchell Buffing and Polishing Lathes.


Spindle Lock Through Pulley Cover
Motor, out of Dust Area, is Easily Accessible for Maintenance
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Motor Mounted on Sliding Base
Foot Operating Pedal
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BUFFING COMPOSITIONS • METAL POLISHERS AND ELECTROPLATERS SUPPLIES-EQUIPMENT

THE MONTHLY

Review

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CONTENTS

OEMING—Stream Pollution Problems in the Electroplating Industry 601

HERWIG—Black Anodic Coatings on Aluminum Alloys 609

WININGER—Cyclic Plating of Hard Chromium On Turbine Rotor Journals 617

FERGUSON—A.E.S. Research Project #3, Adhesion of Electrodeposits, IV 620

Research Report Available 635

Letter from Adelaide Branch President 668

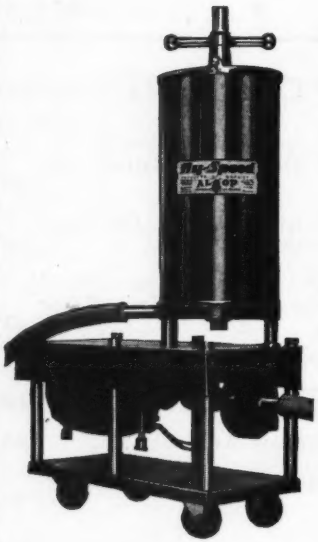
DEPARTMENTS

Book Review 636
Abstracts 638
Industry News 644
New Equipment, Material & Supplies 655
Branch News 663
Membership Report 669
Branch & A.E.S. Officers Directory 674
Advertisers Index 677

Subscription: $3.00 a year
$.50 per Copy

Entered as second class matter September 14, 1945, at the post office at Paterson, N. J., under Act of August 24, 1912.

ALSOP "Sealed-Disc" Filters
meet plating room requirements



The Alsop Filter was designed especially to meet the most exacting filter requirements on practically all types of plating installations and that is why thousands of them are doing a perfect job in plating rooms, large and small, all over the world. They do not require filtering powders or slurry mixing tanks.

Check your *Filter Requirement Specification Chart* and note all of the outstanding features of the Filter.

Write us today giving details of solutions to be filtered, there's no obligation, or contact your regular supply dealer.

FILTER REQUIREMENT SPECIFICATIONS

LIQUID TO BE FILTERED	Practically every type of electroplating solution in both continuous and still tank installations.
IMPURITIES TO BE REMOVED	Dust, rust, sludge, all minute particles of suspended matter and sediment which might collect on work and spoil an otherwise perfect finish.
CAPACITY OF FILTER	To be used on our smallest to our largest tanks. Under certain conditions consider using small individual filters for each tank.
FILTER CHARACTERISTIC	Should be portable and easily moved from one tank to another and cleaned with a minimum of labor and time by our most inexperienced help. Motor, pump and bearings must be protected from damage caused by spilled or splashed liquid.
FLOOR SPACE REQUIREMENT	Due to extremely crowded conditions, filter should not require more than a 9" x 20" floor space for a 600 g.p h capacity. Or other sizes in proportion.
OPERATION REQUIREMENT	Filter must be ready for instant use, also foolproof so that it is impossible to put any plating unit out of commission due to faulty filter operation.
NO LIQUID LOSSES	Filter should be completely sealed - to eliminate dripping or leaking. Due to corrosive action, all valves requiring packing should be eliminated.
TYPE OF FILTER	The new "Sealed-Disc" Filter made by Alsop Engineering Corporation fulfills all of the above requirements and should be given your most careful consideration.

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ENGINEERING CORPORATION
Filters · Filter Discs & Sheets · Mixers · Agitators
106 Fine Street, Milldale, Connecticut

No SHORTAGE HERE!

Having trouble getting cotton buffs and polishing wheels? Try *FELT*

Felt wheels or buffs, properly selected as to hardness, can perform many operations as well as, if not better than Cotton or other Polishing Wheels. They hold the abrasive and their shape better. They produce a higher finish and expedite subsequent buffing. And they have exceptionally long life.

There is no shortage of Paramount Brand FELT WHEELS. Through our distributors or direct we can supply wheels of any desired hardness, diameter, and thickness.

Write us about your polishing wheel requirements, giving type and size as well as work to be performed. We feel confident we have a felt wheel that will do the required work satisfactorily . . . perhaps even better than before.

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BACON FELT COMPANY

"America's Oldest Felt Manufacturers"

Winchester, Mass. Established 1824

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Cowles FAST ACTING EMULSION SOLVENT CLEANER

LIXOL works fast and is a dependable emulsion cleaner for still tank, pre-soak or washing machine equipment. It can be used straight or diluted with water or kerosene.

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- LIXOL cleans thoroughly
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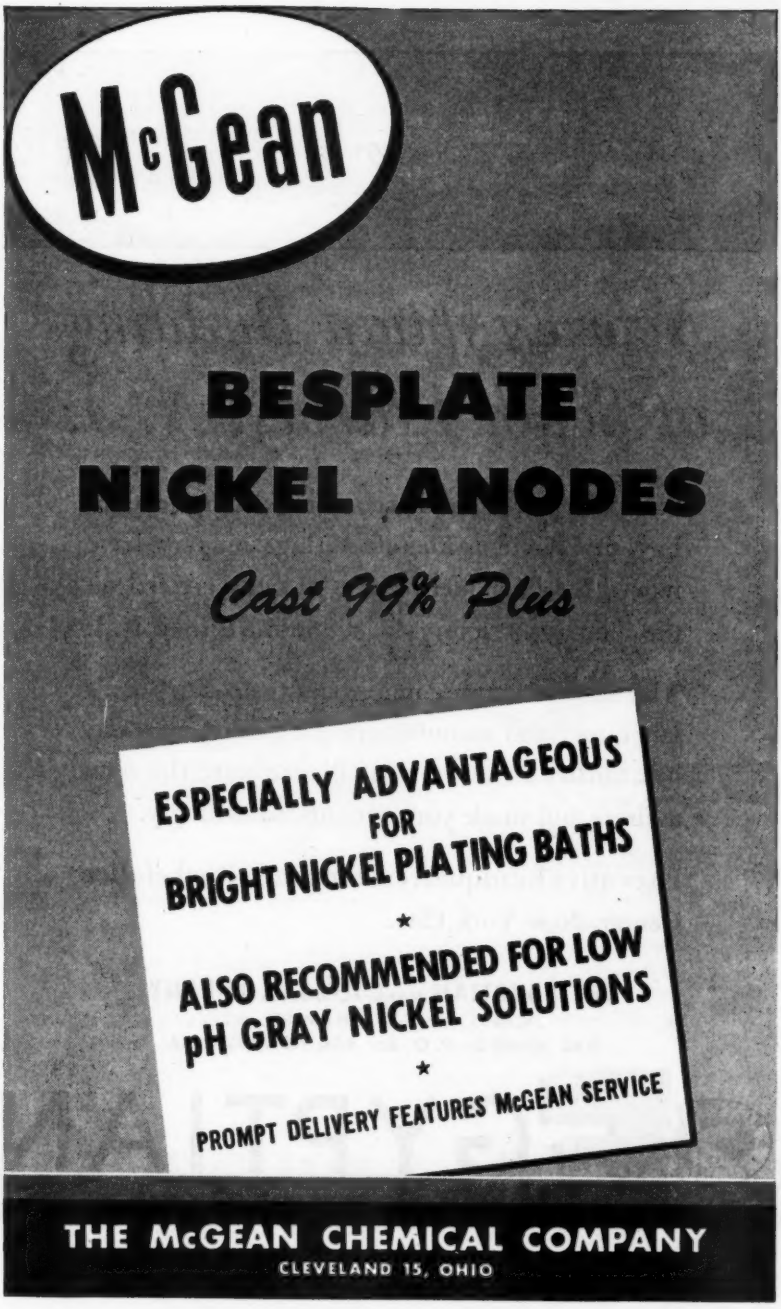
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BESPLATE
NICKEL ANODES
Cast 99% Plus
ESPECIALLY ADVANTAGEOUS
FOR
BRIGHT NICKEL PLATING BATHS
★
ALSO RECOMMENDED FOR LOW
pH GRAY NICKEL SOLUTIONS
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New Egyptian Building at South Kearney, N. J.

Sales, advertising and accounting departments of Egyptian Lacquer Manufacturing Company have moved into a modern home recently erected on the company's factory site at South Kearney, N. J.

The new structure, in proximity to Egyptian's laboratory and manufacturing facilities, increases our ability to serve you. Please note the new address and mark your records accordingly.

Executive headquarters remain at Rockefeller Center, New York City.

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MAIL ADDRESS—P. O. Box 444, NEWARK, N. J.

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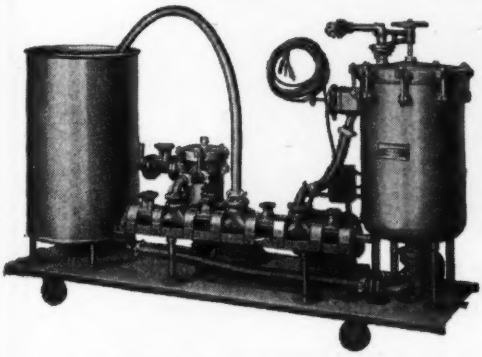
SPECIALIZED PRODUCTION FINISHES

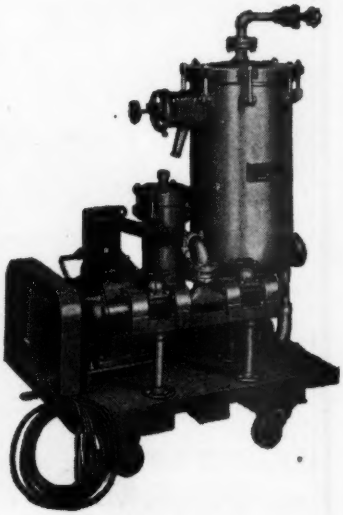
FOR GREATER *Efficiency* AND *Economy*
INSTALL MODERN INDUSTRIAL FILTERS IN YOUR PLATING PLANT

You can keep your plating plant operating at top efficiency only if you have adequate filtration. Industrial filter systems are designed and built to provide continuous high speed filtration and circulation.

Industrial Filters equipped with the AIRWASH cleaning feature have been in continuous use for months without opening the filters or removing the plates. Air agitation quickly dislodges the accumulated sludge and leaves the filter clean and ready for a new filter cycle. Many hours of production time are saved thus lowering your operating costs.



No. 1—Filter shown is equipped with slurry tank with double suction and discharge control providing an ideal continuous filtration system.



No. 2—A typical portable filter as constructed for bright nickel, acid copper and other acid type bath. Used for either intermittent or continuous filtration.

Other Products

Salt Fog Corrosion Test Equipment

Centrifugal Pumps of Duriron, Worthite, Stainless Steel, Hard Lead, Bronze and Iron.

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For efficient, low-cost **PLATING AND ANODIZING** *with* **G-E Copper-Oxide Rectifiers**

The great flexibility of General Electric copper-oxide rectifiers permits a choice of power to meet varying demands. They can be grouped in parallel to handle heavy current loads or in series to obtain highter voltages for special processes. A G-E installation can be set up or changed quickly. No special foundation or expensive accessories are required. There are no moving parts other than a ventilating fan, and maintenance is negligible compared with other types of plating equipment. Adjustment is controlled at a-c input to keep current cost at a minimum.

Write for illustrated booklet. Section A6612-106, Apliance and Merchandise Dept., General Electric Co., Bridgeport, Conn.

GENERAL ELECTRIC

ANOTHER HARSHAW DEVELOPMENT FOR BETTER PLATING

NEW SINGLE NICKEL SALTS

More and more platers are voicing their enthusiasm about the plating advantages of Harshaw's New Single Nickel Salts. These small definite crystals are superior to the large old style nickel salts. In addition to uniformity in crystal size and shape, these small $NiSO_46H_2O$ crystals are the purest, highest nickel content nickel salts we have ever made. They dissolve rapidly and flow freely. When kept in reasonable storage, lumping and caking are eliminated. • Join the increasing number of platers who are specifying Harshaw's New Single Nickel Salts. Send your order to the nearest Harshaw branch.

NEW SHIPPING PACKAGE—This new type of nickel salts now makes possible the use of strong 5-ply paper bags containing 100 lbs. net. Easy to handle—they stack conveniently and pour in a free flowing stream.

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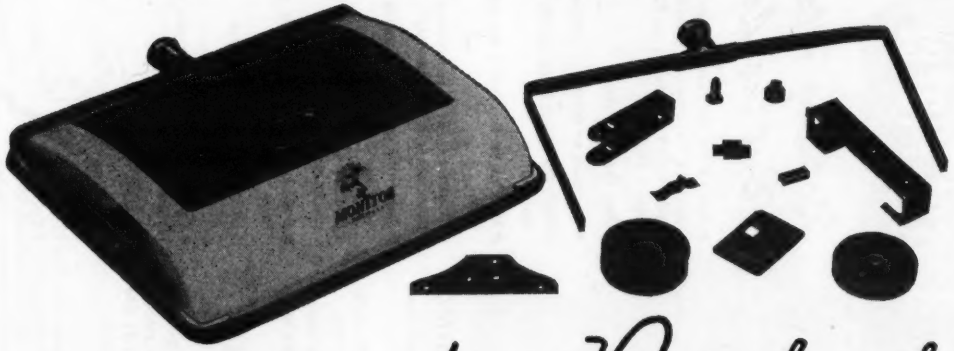
THE NEW MONITOR SWEEPER

PENTRATE PENTRATE PENTRATE PENTRATE PENTRATE

THE NEW MONITOR SWEEPER

Manufactured by WHITE AIRCRAFT CORP., Palmer, Mass.



with **BLACK** *by Pentrate*

This sleek new MONITOR Sweeper is finished in bright blues and reds accentuated by lustrous Pentrate black. Pentrate can't crack, chip, peel or rub off. And because it imparts durability and protection as well as appearance, the inside working parts of the MONITOR have been Pentrated too! Look at your own product. If a deep, rich black, either as a basic color or as trim, would add that sales-appealing punch, write for further information.

HEATBATH CORPORATION

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In Canada — WILLIAM J. MICHAUD CO. LTD. — Montreal

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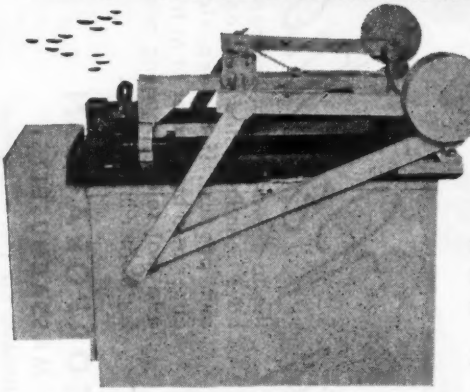
FOR FAST PLATING...

Lasalco's New

Intermediate Barrel Plater



Nothing Plates But the Load

- Serves for all jobs requiring capacities between a small utility plater and regular size Richards Barrel Plater.
- Just the *right* size
- For acid or alkaline solutions
- Built for quick loading and unloading
- Maximum flexibility for many jobs
- Requires less operating effort than other barrel platers
- Carefully counterbalanced for easy handling
- Speeds up and increases production
- Can be used for a still plating tank
- Unloading trays are not necessary
- Cylinder and gears made of hard rubber

QUICK AND EASY LOADING

- Note how cylinder is swung forward and head is held in position for loading.
- Switch type negative contact is made automatically when cylinder is lowered into tank.
- Insulated negative connection through hollow hub of cylinder prevents interference while loading or unloading.

SIMPLIFIED TIME-SAVING UNLOADING

- Automatically placed in position for unloading, cylinder is secured by handle and ratchet arrangement. Load can be emptied right into tote baskets — unloading trays are not necessary.

⅛ h.p. motor; 3 speeds—2, 4 or 12 r.p.m.; inside dimension of cylinder—10" dia. x 18"; capacity 8 qts., or 30 lbs., maximum; constructed with steel tank for cyanide solutions, or rubber lined tank for nickel solutions.

LASALCO, INC.

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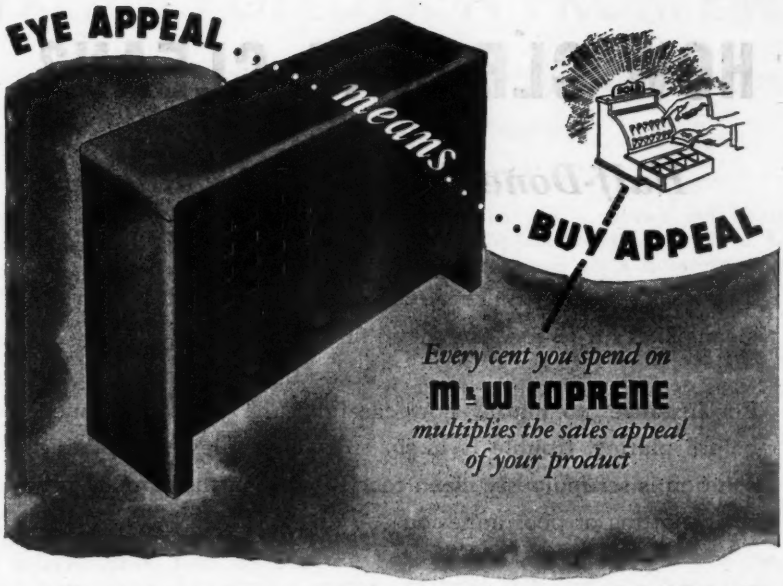

M & W Coprene air-drying enamels increase the sales appeal of such products as metal or wood cabinets, furniture, air-conditioning equipment, and many other special products where a handsome, high-gloss, chemical-resistant finish is desired. They protect and prolong the life of such products because of their excellent adhesion to steel and great resistance to weather and most chemicals.

Coprene can be supplied in plain air-drying enamels, synthetic metallic enamels that air-dry to a lustrous metallic finish, or in air-drying Hammertone finishes. Coprene air-dries dust-free in a few minutes and hard overnight, but can be force-dried. Available in standard colors in: plain enamels, synthetic metallic enamels or Hammertone finishes.

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PRODUCERS OF LACQUERS, ENAMELS, SYNTHETICS AND SPECIAL PRODUCTION FINISHES

HOW CLEAN IS CLEAN?

Half-Done Jobs Aren't Enough!

The week's laundry isn't really of much use unless it is *entirely* clean. That's true, too, of a metal finishing job.

For instance, no matter how carefully the work is cleaned before plating, trouble is likely to follow unless the plating solution is scrupulously clean too. Trouble in the form of pitting, spotting or poor adhesion.

DARCO S-51 is an activated carbon, especially made to eliminate such headaches. By the process of adsorption, it removes grease, oil, soap, colloids and other decomposition products from the plating bath — *permanently.*

Applicable to a wide range of metals — bright nickel, cyanide zinc, cadmium, copper, iron, gold, silver — DARCO S-51 saves time and labor, and a few cents' worth purifies 100 gallons of solution a week. Get DARCO S-51 working for you!

(This trademark identifies the genuine. Accept no packages without it.)

DARCO

DARCO CORPORATION

60 E. 42nd Street, New York 17, N. Y.

DARCO—REG. U. S. PAT. OFF.

Is Your Plating Bath as Clean as the Water Used in Your Final Rinse?

STREAM POLLUTION PROBLEMS

In The Electroplating Industry

By L. F. Oeming, Sanitary Engineer

Michigan Steam Control Commission, Lansing, Michigan

POLLUTION of streams may be defined in a variety of ways. The definition which concerns not only state regulatory agencies acting in the public interest but rights of individuals as well, is derived from the common law of waters. Through its "reasonable use" doctrine, the common law lays down the basic principles to be observed by all users of water. In substance, it states that the water resources are held for the benefit of the people as a whole and no single use can take precedence to the exclusion of others.

The authority of state agencies to control pollution arises from the basic common law supplemented by statutes enacted by the several state legislatures. These statutes differ in methods of procedure and limitations imposed to meet particular conditions within the individual state, but fundamentally they are linked with the common law in declaring unlawful such pollution as is unreasonable and against the public interest. Under this general policy, the jurisdiction of the states has been extended to control of pollution which creates specific injury to public health or fish life.

The Pollution Problem

An examination of some of the effects will serve to illustrate how failure to control its effluents brings the plating industry in conflict with the concepts of "reasonable use" of streams for waste disposal.

The highly toxic nature of the chemical compounds used in electroplating causes wholesale and widespread destruction of fish and other forms of aquatic life. Cyanides in minute concentrations kill almost instantly. Compounds of many metals such as copper and zinc both cause rapid killings and also have cumulative effect resulting in delayed death of fish. Lethal limits of many of the constituents of plating wastes have been established and are published in a bulletin entitled "Detection and Measurement of Stream Pollution" by M. M. Ellis.

Cyanide wastes are a menace to sources of public water supplies. An example is found in the case reported on the White River above the water supply intake of the City of Indianapolis, Indiana, in 1944. Another occurred in a small community where percolation from impounded wastes endangered both municipal and industrial well water supplies.

Agricultural interests suffer damage when livestock is killed on watering in cyanide bearing streams.

The germicidal action of the various chemical pollutants on organisms in the streams interferes with the normal biological processes of natural purification. The ability of the streams to assimilate other wastes is greatly reduced and depreciation of stream quality results.

Where wastes enter a municipal sewage plant, the treatment process has been impaired thereby causing an inferior quality of effluent to be produced. They reduce the purification efficiency of trickling filters and aeration processes of sewage treatment by destroying the essential organisms. Copper, chromium and zinc are notable offenders as inhibitors in the digestion of sewage sludge. Control of bacterial pollution from sewage is disrupted by interference of the wastes with chlorine disinfection.

Receiving waters are often rendered unsightly by color and oil in the waste discharges. Chromium compounds are particularly troublesome by reason of the persistence of their color.

From analyses of the circumstances accompanying a large number of these problems, it is possible to define several factors which recur most frequently as the principal causes of pollution.

Little or no attention is given to the wastes as they leave the process. If suitable

drainage of the plant can be obtained, no concern is given to the strength or volume of waste or the point of ultimate discharge. Seldom does management know whether the wastes enter the stream directly through an individual outlet, or by way of connections to municipal storm sewers, or through sanitary sewers with or without subsequent treatment. Too often there is no information available as to how the plant is sewered or where the connections lead.

Certain of the constituents of the wastes are extremely injurious in minute concentrations. In most instances there is a lack of understanding of the permissible limits of concentration and of the hazards created when they are exceeded.

Dependence upon dilution with other plant wastes or with the stream for disposal of concentrated baths has been misplaced by failure to recognize the limitations which this method offers. For example, dilution with 250,000 gallons of water is necessary per gallon of cyanide dip solution containing 8 oz/gal NaCN, to reduce the concentration to a value which can be tolerated by fish. Few if any plants have sufficient quantity of cyanide-free wash and rinse waters to dilute their baths to such a low strength. While the receiving stream might furnish such volumes, it must be recognized that only a small portion of the stream flow is utilized unless special provision is made for discharge of waste at controlled rates and mixing with the river flow. Failure of this method has occurred where the stream is subject to flow regulation by power dams or grist mills. There, the dilution factor is materially reduced or eliminated during periods of stream flow storage and concentrations of pollutants are raised to the toxic range.

Division or lack of responsibility for control and disposal of wastes has resulted in many instances of pollution. Recognition of the problems presented by the wastes has not been developed among the plating room personnel. No attempt has been made to define the duties or responsibilities of disposal nor to delegate authority over this phase of operations to a competent individual. Instances have occurred where such control, once established, has failed due to changes in plating room personnel and neglect in informing new employees of the problem or disposal practices.

Labor and time consuming methods result in the tendency to seek short cuts in performing disposal operations. Controls that involve hand bailing and carrying of tank contents have proven undependable. They result in dumping to the sewers of untreated or inadequately treated wastes.

Accidental losses of production baths or impounded wastes account for another class of problem. They occur from leaks in tanks or failure of valves and piping within the plating room. The contents of ponds in which wastes are stored are released to streams by breaks in the retaining dykes.

Cancellation of government contracts for war materials in late 1945 was followed by suspension of portions or all of plating room operations and revisions of production and practice throughout the industry generally. Indiscriminate disposal of obsolete baths resulted in an epidemic of pollution cases after VJ day.

The Wastes

From the standpoint of pollution control, there are in general two major classifications into which the plating room wastes can be placed. Overflows of hot and cold waters from rinse tanks, drainage from water sprays and tumbling barrels are *continuous sources* of waste flow to the sewers. Superimposed upon the normal steady discharges resulting from production operations are the *intermittent discharges* which constitute the second classification. These consist of batches of spent, spoiled, obsolete or otherwise unusable baths containing the solutions used in the preparation of the metals and for plating.

It is difficult to relate waste volume to any unit of production. The size, shape and type of the parts and number of rinses needed to remove the undesirable constituents are all variables which do not directly influence the water usage. Quantities of water needed do not appear to be established to the same degree as the concentration of the electrolytes. As a result, some excess of water is oftentimes consumed over that necessary for good production.

Rates of overflow from running rinse tanks range from 1 to 4 gallons per minute with three gallons being a fair average. Tumbling barrels use in the neighborhood of 5 gallons per minute for the rinsing

operation. The only sound basis for determining the waste volumes lies in direct measurement, either by a water meter on supply lines or by devices in sewer.

The continuous discharges carry all of the constituents used in the plating process. Among those found present are suspended particles of dirt, grease and metal; metallic ions of copper, chromium, nickel, cadmium and zinc; cyanides, acids and others too numerous to mention.

The intermittent wastes are the most important as the cause of pollution. Tank sizes ranging from the 25 gallon crock in the small job shop to 5000 gallons and upwards in production plating establishments are an index of the volumes which must be disposed of at intervals. The reasons for such discharges lie in the chemical changes which occur that render them unsatisfactory for further use. Examples are found in the accumulation of carbonates in cyanide baths, excessive amounts of sulphate in chromium solutions used for anodizing, loss of scale removing properties in acid solutions and the like. In general, the electrolytes are of such value that effort is made to restore them to use and much attention has been devoted by the industry to this subject. However, where capable chemical laboratory service is not available, or where too much time and trouble is involved, no attempt is made to restore the baths and they are discharged, all claims to the contrary notwithstanding.

Some of the process baths that have been found to be discarded with resulting damage to the stream and their harmful ingredients are:

1. Chromium plating: chromic acid, sulphuric acid
2. Zinc plating: zinc cyanide, sodium cyanide
3. Cyanide copper plating: copper cyanide, sodium cyanide
4. Anodizing: chromic acid, sulphuric acid
5. Dips: sodium cyanide, nitric acid, hydrochloric acid
6. Bonderizing: chromic acid
7. Cleaners: caustic soda

Methods of Control

The adoption of control methods has as its objective the reduction in pollution constituents of the wastes entering the sewers. Any waste source which can be prevented, diverted to other uses, or eliminated by improved production practice, reduces the expense and difficulty of treatment that may be ultimately required. Examples have been found in many types of industry where control has eliminated the need for further treatment or at least has reduced the extent to which it must be carried. It is therefore sound procedure to explore and apply every advantage of control as a first step in the solution of the problem.

Utilization of waste has received some attention in the plating industry. The opportunity appears to be far less than in many other industries, but a few methods are worthy of widespread application.

The substitution of a dip tank for a rinse immediately following the plating bath markedly reduces the amount of the electrolyte lost to the sewer. The solution so collected is returned to the bath.

In conveyorized systems, a drainage interval following emersion of work from the plating baths permits collection of drag-out for return to the bath, or the conveyor can be designed to pass through a dip tank for recovery of the electrolyte and its return to the plating bath.

Some progress has also been made in the field of by-product recovery. A method for recovery of chromium trioxide for use as chrome green pigment has been reported in operation. The chromium is reduced to trivalent form with sulphur dioxide and precipitated with caustic soda or soda ash. The precipitate is dewatered, dried and roasted at 500°C.

Preparation of a solution for tanning leather from waste chromic acid liquor in the anodizing process has been reported.

Expensive metals such as cadmium, silver and nickel have been recovered by electrolysis from dip tanks in which drag-out has been collected.

Separation of sewers and segregation of the various waste sources reduces the volume of wastes which must be treated. Routing of the weak wastes to the sewer or stream, and diversion of the concentrated electrolytes, acids, alkalies and first rinse waters to tanks or sumps for ultimate treatment or disposal, result in treatment units of smaller magnitude and consequently lower outlay and maintenance cost.

Methods of Disposal

Strong acids and alkalies may be handled by interaction and neutralization. In this method, the solutions are drained to holding tanks where they are mixed and then discharged at controlled rates over an extended period to the sewer. Equivalent results can be obtained by draining to ponds together with weak wash waters. Such ponds will equalize the flow, settle the solids and effect neutralization by the buffering action of the various components passing through the pond to the sewer. This method is inapplicable to plating baths.

A method which has been widely used in the industry depends upon percolation from impounding reservoirs. Such ponds are constructed with no overflow to the stream and should receive only the concentrated solutions and first rinse waters. For successful operation, it is essential that they have adequate capacity based upon expected volume and upon tests to establish seepage rates, that they be situated remote from private or public wells and be protected against human or animal contact. Frequent relocation of the ponds can be expected as the seepage rates gradually decrease due to sealing of the soil by sludges.

Sub-surface irrigation has been adopted for strong wastes and limited amounts of rinse waters. This system requires pre-settling of the wastes and their distribution to the sub-surface through a system of vitrified tile drains. Again a porous soil is essential and precautions must be taken to protect well waters from contamination.

Methods of Treatment

Situations are frequently encountered where lack of sufficient area or other restrictions make it impossible for ponds to be used. If control or disposal methods fail to provide the desired protection, one or more methods are available for treating wastes to remove undesired constituents.

Metals are removed by flocculation and precipitation with the aid of chemical coagulants. The most common reagents for removal of most metals are alum or ferric chloride in combination with lime.

Removal of *chromium* has been the subject of extended investigations by the Connecticut State Water Commission. A treatment process has been devised whereby the chromium is reduced from hexavalent to trivalent form with barium sulphide or similar reducing agents fed to the wastes. Addition of lime then precipitates the metal as a chromium hydroxide sludge which is dewatered on sand beds. Satisfactory treatment of waste containing 100 ppm of chromium is told using 4 pounds of barium sulphide and 2 pounds of lime per 1,000 gallons.

When the process was employed for treating combined plating room wastes, it was supplemented by pretreatment with acid to a pH of 3.0 to volatilize the cyanides. Operating on a fill and draw basis, it gave complete removal of chromium and substantial reduction in *copper* and *cyanide* with dosages of 10 pounds of barium sulphide and 5 pounds of lime per 1000 gallons of waste.

At the Ford Motor Company's Willow Run Bomber plant, fill and draw operation on chromium wastes, using ferrous sulphate and lime, gave removals in excess of 99 per cent.

Cyanide removal by decomposition with sulphuric acid has proven to be an effective means of treating concentrated solutions. The facilities required consist of a tightly covered receiving tank, rubber lined or otherwise coated to prevent corrosion and equipped with an air blower and vent stack. The spent solution is discharged to the tank, sulphuric acid is added and the contents are agitated by air blown through the solution. The cyanide is volatilized as hydrocyanic acid which is exhausted into the atmosphere through the vent stack. With the addition of sufficient acid and an aeration time of about 16 hours, the cyanide is reduced to less than one part per million and the treated solution can be discharged to the stream. The poisonous character of the evolved gases requires that the vent stack be high enough to prevent danger from the fumes.

The Chevrolet Division of the General Motors Corporation at Flint, Michigan, has operated such a treatment process since 1934, and similar treatment was performed at the Willow Run Bomber Plant during its wartime production period. The Chevrolet installation comprises a 5,000 gallon tank with a 60-foot vent stack. In a typical treatment operation, 4,500 gallons of solution containing 2.8 ounces of copper cyanide and 1.1 ounce of free cyanide per gallon were treated with 4,255 pounds of 66°

Baumé sulphuric acid. The cyanide concentration was reduced to 0.98 ppm.

Cyanide may also be removed by oxidation with potassium permanganate. A sludge is formed consisting of manganic hydroxide and calcium carbonate in an amount of 5 per cent of the volume treated. Although non-toxic to fish, the sludge presents a problem of disposal in itself. The end product cyanate has a toxicity threshold for fish of 125 to 250 parts per million. The installation required for this process will be less expensive, but operating costs will be higher than for acid treatment.

A method for converting cyanide to non-toxic cyanates is described in a patent (No. 2,194,438) assigned to the E. I. du Pont de Nemours and Company. The reacting substance is calcium polysulphide which is available commercially as lime sulphur both in powdered or solution form. Required dosages are 0.43 gallon of lime sulphur solution (29.75 per cent calcium polysulphide) or 1.84 pound of solid lime sulphur (70 per cent calcium polysulphide) per pound of sodium cyanide present. The reaction time is given as two hours at room temperature or one-half hour at boiling temperature. The hydrogen sulphide produced in the reaction should be removed from the treated effluents prior to discharge either by aeration or by liberation with acid. Equipment needed is inexpensive and the process is simple to control. It is adaptable to the treatment of cyanide ash from carburizing processes as well as wash and rinse waters. Experiments conducted by the Michigan Institute of Fisheries Research show that sodium thiocyanate is 600 times less toxic than potassium cyanide and that the thiocyanate radical is 1,000 times less toxic than the cyanide radical. Discrepancies were found when treated wastes were used, indicating that some free cyanide remains. Reduction of the residual cyanide may be accomplished by retaining the treated effluents in ponds for an extended period. The reaction is "reversed" with chlorine which produces toxic cyanogen chloride. In consequence, precaution must be exercised where the effluents reach municipal sewage treatment plants which employ chlorine for disinfection. The effects upon sewage treatment processes have been studied and found to be of minor consequence within the ranges which might reasonably be expected.

Recent studies and developments in alkali-chlorination have produced another method capable of reducing concentrations of cyanide to less than 1.0 part per million. It entails oxidation of the salt with chlorine to cyanate, carbon dioxide, ammonia and sodium chloride. The procedure was the subject of a patent application in 1939, later rejected. Various reagents have been proposed to obtain the desired reaction such as commercial bleaching powder, sodium hypochlorite and liquid chlorine.

Several features have been encountered with bleaching powder which make it unacceptable. It produces excessive quantities of sludge when used in solutions exceeding 5 per cent in sodium cyanide concentration, and presents mechanical difficulties in handling and placing into solution the large quantities of powder required for the treatment of comparatively small volumes of electroplating solutions. The high cost of chlorine in this form presents a further obstacle to its adoption. Its use is therefore limited to small scale work or where weak solutions are to be treated.

Sodium hypochlorite overcomes some of these objections but does not seem to be practical for large scale treatment.

The widest range of adaptability is offered by the use of chlorine, either as liquid or gas, and caustic soda. The treatment requires that chlorination be performed under highly alkaline conditions to avoid formation of cyanogen chloride and nitrogen trichloride. Maintenance of a pH of not less than 11.5 in the waste during treatment is recommended. Chlorine requirements range from two to three pounds per pound of sodium cyanide, depending upon the nature of the reducing agent in the waste solution. Copper is precipitated from electroplating baths as the basic carbonate. Removal of zinc requires addition of carbon dioxide or sodium bicarbonate. Needed equipment includes a receiving or holding tank so proportioned as to furnish a 6 foot depth of liquid, a platform scale to enable measurement of the amount of chlorine used, and a porous diffuser through which the chlorine is fed into the liquid. The process is being studied for the effects which the end products might have on fish life and sewage treatment plant operation.

Recommended Waste Disposal Practice

A full recognition of the waste problem on the part of both management and plating room personnel is a necessary prerequisite to the success of any abatement measures. Many troubles can be anticipated and alleviated if effort is made to acquire knowledge and appreciation of the pollution effects of the wastes.

In order to be equipped properly to inaugurate and maintain control measures, one must give attention to such items as the layout of the plant sewer system, its ultimate discharge point, and the type and characteristics of the receiving water. An evaluation of the various possible sources of contamination should be obtained. This will serve to reveal where the pollution is originating. When related to the stream or other outlet conditions, this information will assist in determining the type and degree of abatement needed.

Loss of electrolytes to the sewer should be reduced to a minimum by installing dip tanks for collection of drag-out or drip. Metals should be recovered from drag-out dip tanks by electrolysis. Indiscriminate dumping of spent or spoiled electrolytes to sewers should be prohibited.

Control of waste handling and disposal methods must be firmly established to insure dependability. It will be effective only when a reliable and competent employee is designated to be responsible for waste disposal. Such duties as inspecting, supervising and maintaining waste disposal operations, sampling and analyzing of wastes should be included in the assignment.

Avoid any unnecessarily difficult or complicated procedure when devising treatment or disposal systems. There is ample opportunity to apply ingenuity, but haphazard and makeshift methods tend to fall into misuse in a short period of time. The hazards from the wastes are of sufficient magnitude to merit good equipment and its availability when and as needed. Delays in obtaining pumps, drums, or transportation when the need arises are generally disastrous to the stream. Systems that require more than a minimum amount of manual labor for operation invite short cuts which result in pollution. For example, no confidence can be placed in the hand bailing of contents of tanks and the carrying of solutions to a disposal container or pond as a means of preventing their entrance to the sewer. The best of intentions will not offset the fact that less time and effort is expended by dumping part or all of the solution to the floor drain.

The only satisfactory way to remove spent cyanide or similar strong baths from the plating room is by draining through an enclosed system of piping directly connected to a permanent tank or sump. The standard type tanks used in plating have no outlet or drain. Nevertheless they are pollution hazards and can be made less so by fitting them with drains and valves leading to a sump outside the plating room. (*Editor's Note*: Valves are liable to "freeze" unless used frequently.) This will eliminate delays in restoring the bath to production and holds the solution for ultimate disposal or treatment at an opportune time by the methods described. Production delays occasioned by waste handling must be avoided in any control plan that is to be effective. Treatment of a bath should therefore not be performed in the plating tank.

Minimum Requirements

Certain minimum requirements must be observed in the correction of injuries and abuses caused by the industry's wastes. Additional restrictions are necessary in specific instances contingent upon abnormally low stream flows, or greater than average development and use of receiving waters. The objectives sought are summarized by the following:

1. *Removal of cyanide* to 1.0 part per million or less. Fish will not tolerate concentrations of cyanide in excess of 0.1 part per million as cyanide or equivalent 0.25 part per million as potassium cyanide.
2. *Neutralization of acids or alkalies* to maintain a pH range of 5.8 to 8.2.
3. *No batch discharges* which will produce wide variations in waste strength or composition. Exclusion of cyanide sludges from sewers or drains.
4. *Freedom from unnatural color or surface oil film* in the receiving stream.
5. *Removal of suspensoids* which blanket the stream or lake bottom.

(*Continued on page* 668)

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BLACK Anodic Coatings on ALUMINUM ALLOYS

ROBERT S. HERWIG
Chief Plating Engineer
Bogue Electric Company, Paterson, N. J.

Standard Practices

THE method of obtaining a black anodic coating on aluminum alloys discussed here is patented by the Aluminum Company of America. In general, it consists in treating the aluminum anodically in a solution of 15 to 25% sulphuric acid for a period of 15 to 90 minutes at temperatures ranging from 67° to 88°F, and current densities of 2 to 18 amperes per square foot. The resulting anodic coating is immersed for 10 to 30 minutes in a black dye bath maintained at 140° to 160°F and then sealed in either hot water or nickel acetate solution. Since, as in electroplating, it is difficult to estimate surface area, voltage control is used more frequently than ampere control. The voltage necessary to obtain 12 amperes per square foot varies from 9 to 21 volts depending primarily on the alloy, and on bath temperature and concentration.

As can be seen from this brief description, time, temperature, concentration, and current density are varied within wide limits. This is necessary because of the many different type of alloys and tempers in which aluminum is supplied. These variables present some difficulty to the operators of the process. Even slight modification of any one variable to meet the requirements of one alloy results in an anodic coating on another alloy, which on dyeing either becomes black but sooty, or does not absorb any dye. The black, sooty coatings can be buffed rather easily to high luster but cause difficulty when enameled.

The variables mentioned are relatively easy to control by the use of two or more baths or a tank with both cooling and heating arrangement. However, many shops have space for only one anodizing tank, or the volume of work does not permit the loss of tank time while adjusting the bath to the desired operating temperature.

For this reason and the fact that 70°±2° F is the recommended temperature of a bath for anodizing aluminum alloys which are not to be dyed, many users arbitrarily maintain their anodizing bath at 15-18% sulphuric acid and at a temperature approximating 78°F. At this concentration and temperature with 12 amperes per square foot, a coating results that dyes to a fairly good black in 45 minutes, with nigrosene crystals. However, if the temperature creeps up a degree or two, or if the operator leaves the work in the bath 5 minutes longer than prescribed, a sooty black deposit will invariably be found on aluminum alloys of the copper containing type. On most parts, this is not particularly serious. When such parts, however, are painted, the finish will usually show minute blisters or a roughened surface, even if brought to a mirror finish prior to painting. In the case of parts having deep recesses or sharp corners, particularly optical assemblies, there is a danger that the soot in recesses may come off during assembly and subsequent handling and cause mechanical interference. Also, this soft black deposit is readily removed from sharp corners during buffing, leaving a shiny, white surface which sets up undesirable reflections in the optical system.

Objectives

In view of the foregoing, it was desirable to regulate bath conditions so most aluminum alloys could be treated in a bath of one concentration and temperature that would yield coatings equally satisfactory for parts to be anodized only, anodized and dyed, or anodized, dyed and painted. The method had to prevent the appearance of white spots on the surface of porous, anodized and dyed castings. It also had to permit simultaneous anodizing and dyeing of aluminum alloys of both copper and non-copper containing types.

TABLE I

Experimental Anodizing Conditions

Variables	Sulphuric Acid Content, %		
	25	18	13
Temperatures, °F	70,80,90	70,80,90	70,75
Current densities, amp/sq.ft.	12	10,12,18	10,12
Treatment time, min.	30,45,60	15,20,45,60	45,60,75

TABLE II

Experimental Conditions for Dyeing

Dyes	Nigrosene, Nigrosene-Metanil Yellow
pH Values	4, 5, 6, 7
Temperatures, °F	140, 160
Sealing medium	Hot water of 180-190°F

Experimental

An investigation was undertaken to study the sulphuric acid anodizing bath under the conditions set forth in Tables I and II. The aluminum alloys investigated are given in Table III.

The following determinations were made on the dyed parts:

Hardness of coating by polishing with an abrasive and by a scratch test.

Depth of dye penetration measured with a metallograph on a polished cross-section.

Light fastness in an ultra-violet light cabinet, containing a 1200 watt type LL quartz lamp.

Corrosion resistance by means of a standard salt spray fog cabinet. All samples had to pass a 250 hour test without showing any white corrosion spots.

Results

Increasing the acid concentration decreased the hardness of the coating, and increasing the temperature increased the porosity. Both the soft and the porous oxide coatings absorbed the dye very readily at pH of 6-7, but the time for producing a coating which was not sooty became very critical. This was especially true on the copper containing type aluminum alloys which are best represented by our experimental samples of Nos. 353a, 355a and 601, Class 4. The coatings on these alloys were more porous and softer than normal, and therefore, when prepared at a temperature above 75°F and dyed, were inclined to be smudgy. On the other hand, when the non-copper containing type aluminum alloys were anodized for 45 minutes in the 13% sulphuric acid, at a temperature 70°-75°F and at a current density of 12 amperes per square foot, oxide coatings were produced which had a glossy metallic sheen and did not readily absorb the dye in either the Nigrosene or Nigrosene-Metanil Yellow baths. An excellent black hard coating was produced on all the samples when the time of anodizing was increased to 60 minutes at a current density of 10 amperes per square foot and the dye bath pH lowered to 4.5. The increase in time was to allow for an increase in thick-

TABLE III

Aluminum Alloys Investigated

Federal Specification QQ-A-	Description
601, Class 4	*Aluminum-copper casting alloy, solution treated and aged
601, Class 10	Aluminum-copper-silicon-magnesium casting alloy, as cast condition
601, Class 3	Aluminum-silicon-magnesium casting alloy, as cast condition
353a	*Aluminum-copper-manganese-magnesium wrought alloy, solution treated and aged
355a	*Aluminum-copper-manganese-magnesium wrought alloy, solution treated and aged
334	Aluminum-silicon-magnesium-chromium wrought alloy, solution treated and aged
561	Commercially pure aluminum

*Commonly referred to in the trade as a "copper containing type aluminum alloy".

ness of the oxide coating. It was noticed taht when the 13% sulphuric acid bath was operated at 70°F, the current dropped off at a greater rate than when the same bath was operated at a temperature approaching 90°F. This is undoubtedly caused by the slight solvent action on the oxide coating of the warmer sulphuric acid which allows current to pass more readily through the resulting porous oxide coating. The pH of the dye bath was lowered to increase the absorbing properties of the dye by increasing the ion mobility, and at the same time to increase the porosity of the oxide coating slightly to allow additional absorption of dye.

The as-cast samples of No. 601, Classes 3 and 10 did not dye very uniformly. Occasionally, white spots and even streaks would show up on the dyed samples. This we attributed to traces of electrolyte being trapped in the pores. Only occasionally was this difficulty encountered in our regular production castings because of better foundry technique which minimized porosity. Samples which showed white spots were stripped and reworked. Half of them were thoroughly rinsed after anodizing, dipped for 2 minutes in a 5% ammonium hydroxide solution and then rinsed again before dyeing. Half were treated normally without the ammonia dip. The latter samples again showed white spots after dyeing, while those which had been given the ammonia dip had a dull, uniformly black finish.

Because of critical shortages of materials created by wartime demands, it was frequently necessary to use substitute alloys in production. This resulted in considerable difficulty when the parts had to be black anodized. Such an instance occured when identical parts were machined from Nos. 334 and 353a. The parts were buffed to give a smooth, highlighted effect, hung on racks and immersed in the anodizing bath. During the anodizing of these parts, the rack with No. 353a parts gassed violently, while the rack with parts No. 334 showed negligible gassing. On dyeing, the surface of the former became dull, whereas that of the latter remained shiny. If the anodizing time was set to yield an optimum black on the dull coated parts, the shiny coated parts in the same bath would acquire a blue color. On the other hand, adjusting the time for an optimum black on the shiny parts produced soot on the dull coated parts. Hence, aluminum alloys of copper containing type and those of the non-copper containing type cannot be anodized and dyed together.

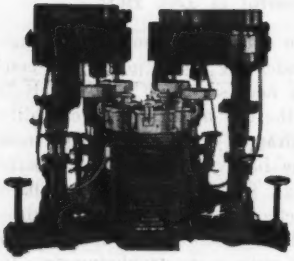
It was concluded that an anodizing bath containing 13-15% sulphuric acid and maintained at a temperature of 70°-75°F would produce hard glossy coatings in 50-70 minutes at a current density of 10 amperes per square foot on samples meeting the requirements of Federal Specifications QQ-A-353a, 355a, 561 and 601, Classes 3, 6 and 10. The coatings dyed very well in a solution containing 1.608 oz/gal of Nigrosene crystals and 0.268 oz/gal of Metanil Yellow at 160°F° and pH 4.5-4.8.

The dyed coating was an excellent paint base; it had been found previously that the coatings produced at higher temperatures or higher concentrations would not enamel as well. This was attributed to entrapped moisture or air or both in the softer and more porous coatings. During the baking operation, the gases diffuse through the paint coating, but some evidently remain causing minute blisters in the finish.

Control of Dye Bath

To achieve consistent results in production runs under the above mentioned conditions, it is necessary that daily analysis be made of the dye bath. Excessive acidity due to the drag-in of sulphuric acid from the anodizing bath will result in a poorly dyed coating. The pH of the dye bath should be determined by means of a glass electrode. The dye content of the bath can be measured with a spectrophotometer. In the absence of such an instrument, reliable indications of the strength of the dye can be had by checking against four standards containing the dyes in ¼, ½, ¾ and full concentration. It is only necessary to dip a piece of filter paper into the production dye bath and compare it visually with pieces dipped into the standards.

The interesting observation was made that a solution containing Metanil Yellow and Nigrosene would absorb 20% more light at a wavelength of 745 microns than one containing no Metanil Yellow but an equal amount of Nigrosene.



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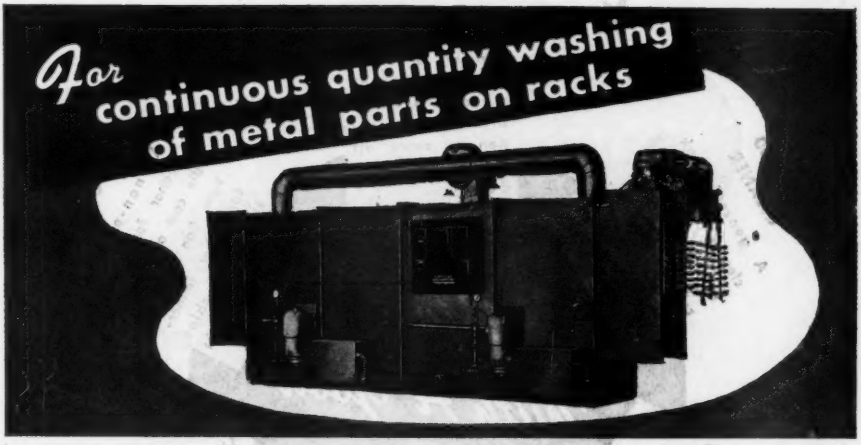

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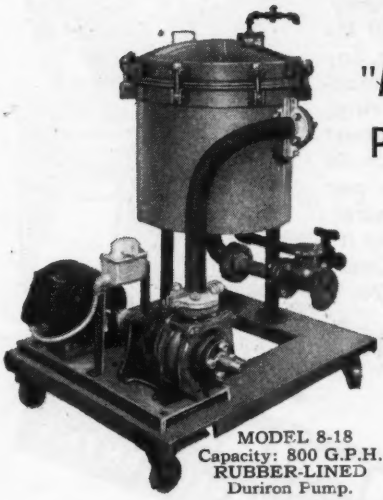

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CYCLIC PLATING OF HARD CHROMIUM ON TURBINE ROTOR JOURNALS

By DEL WININGER
Oakland, California

TURBINE rotors with journals as much as ¼ in. undersize were repaired by chromium plating. Since the unit was too large to be handled in the plating tank, it was placed alongside the tank and a plating cell was built around the journal. The sides and bottom of the cell were made of sheet lead, concentric with the lower part of the journal, and were connected as anode. The ends were made of lucite sheets with openings for the journal to pass through. They also served as insulation. The turbine rotor was rotated in V-blocks of Bakelite, using a ¼ horsepower motor with reduction gear and belting to a drive wheel that was clamped on the end of the turbine rotor shaft. A tent of Vinylite, connected to the blower system, completed the set-up.

The chromic acid plating solution was siphoned out of the tank fast enough to keep the plating cell half filled. Running out around the edges, it was caught in a sump pan and pumped back into the tank. Since the upper half of the rotor shaft was out of the chromic acid, it could be smoothed with a carborundum hand-hone when the plate became rough from treeing. When the plate became too rough for the hand-hone and the effective surface area was increased to such an extent that it interfered with the plating, the plating was stopped, the turbine rotor put in a grinder, and the journal ground smooth. Plating was then continued with repeated interruptions for smoothing the plate, until it was built up to the desired thickness plus 0.010 in. over the finished size. It was necessary to grind once for every sixteenth of an inch of chromium plate.

A temperature of 140°F and a current density of 5 amp/sq.in. were used to keep down time and cost (rate of deposition being directly proportional to the square of the current density). A higher current density was not practical because it would have required a higher solution temperature and caused excessive fuming; also it was limited by available generator capacity. The writer has at times plated at 145°F and about 8 amp/sq.in. but the results were difficult to control and were satisfactory only for work that had to be ground and was wanted in a hurry.

The solution contained 1 lb/gal chromic acid with three per cent of sulphuric acid.

Electrically the system was controlled by the double exciter method, i.e. the generator exciter was in turn excited by a smaller exciter (necessary unless the generator exciter is small enough to be controlled by a panel mounted rheostat) which was controlled by a rheostat. In this control circuit was a reversing switch which permitted the current to pass in either direction. The rheostat and reversing switch is the most important unit in the plant and, with the ammeter, should be mounted near the plating tank for ease of control.

The following method has been found satisfactory for chromium plating on steel and on chromium. The plating can be stopped and started as often as necessary without striations, layers, blisters, and other plating defects being formed.

After the work has been placed in the tank and connected, the generator is started with the rheostat off. The reversing switch is thrown and the current built up immediately in the reverse direction. The work is treated anodically with full current for ten or twenty seconds. Next the rheostat is turned down and the reversing switch is thrown to the normal current direction. The rheostat is turned up very slowly and at a uniform rate over the entire scale, until the desired current density is reached in about one minute. With the work only partly immersed, as in the case of the turbine rotor journals, plating was started by increasing the rheostat one small increment per each revolution of the rotor, until full current density was reached in about five minutes.

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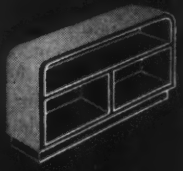

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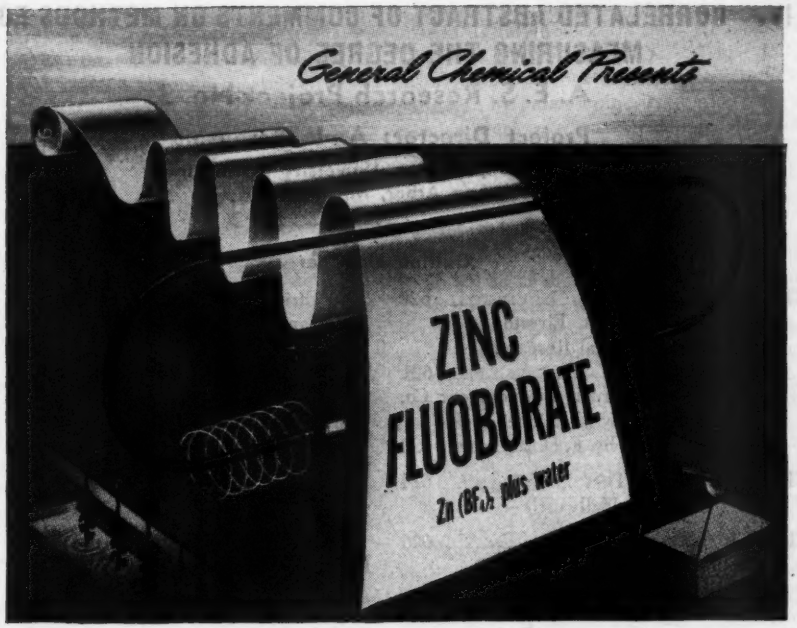

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THE ADHESION OF ELECTRODEPOSITS

IV. CORRELATED ABSTRACT OF COMMENTS ON METHODS FOR MEASURING THE DEGREE OF ADHESION

A. E. S. Research Project No. 3

Project Director: A. L. Ferguson

Chemistry Department, University of Michigan
Ann Arbor, Michigan

Outline of Paper

The Supersonic Test 620
Pioneer work of F. A. Firestone
Experiences of Crystal Research Laboratories 621
Remarks by the Brush Development Co.
Laboratory Tests by J. R. Frederick
Commercial Tests by F. D. Hallworth 623

The Black Light Test 624
Studies by F. D. Hallworth

The Whirl Test 626
Development by F. D. Hallworth

The Chisel Test 627
Variant by F. D. Hallworth

The Roll Test 627
Development by F. D. Hallworth

The Shot Impingment Test 628
Work by A. W. Hothersall and C. J. Leadbeater
The Shot-Peen variant by F. D. Hallworth 633

Other Tests 635
Remarks by F. D. Hallworth

Final Conclusion 635

(Continued from March Issue)

EARLY in the work on this project, persons were contacted who had made a study of the use of high frequency sound as a means for detecting flaws or voids in metals. It was felt that the method might also be applicable to the detection of degrees of adhesion. The studies in question were made in connection with government research and the information obtained could not be presented at that time. However, the promise was given that as soon as a release could be obtained, the material would be made available as a contribution to this project. The last of this information has now been received and the whole is being submitted herewith together with data on other methods recently made available.

The Supersonic Test

The pioneer in the field of supersonics is Professor Floyd A. Firestone, recently of the Physics Department of the University of Michigan, now Consulting Physicist located at 3318 Fessenden Street N. W., Washington 8, D. C. For general information on supersonics the reader is referred to two publications by Firestone [135, 136].

Firestone was asked to make comments, based upon the theory involved and his extensive experience in the field, concerning the application of supersonics to the measurement of bond strength of electrodeposits. The following are his statements:

"A sound wave is the propagation of an elastic disturbance. The velocity of propagation of a longitudinal sound wave in metal is of the order of magnitude of 200,000 in/sec. If the frequency of the sound is 5,000,000 cycles per second, the wave length will be of the order of magnitude of 0.04 in. If a quartz crystal, one-half inch square, is used for radiating the sound, a beam of sound like a search light beam will be formed having a one-half inch square cross-section. If this beam of sound falls upon a plated object at approximately right angle to its surface, then some of the sound will pass through the object and emerge on the other side where it can be picked up by a second quartz crystal used as microphone; but if there is no bond over any portion of this one-half inch square area, then the discontinuity of elasticity will cause the sound to be almost complete-

ly reflected and none will be transmitted. The area under test can, in some cases, be narrowed to about one-quarter inch square; a considerable fraction of this area must have no bond in order that a definite indication be obtained by this technique of sending the sound through the piece.

"In applying this technique, it is customary to send the sound beam through a path in water; the metal part to be inspected is then immersed in this path and the absence of bond will be indicated by the complete interruption of the sound beam. With pieces of certain shapes, considerable difficulty may be experienced because of interference between multiple reflections or existence of standing waves. To overcome this difficulty, the beam of waves may be sent for only a few millionths of a second, the wave group then being so short that standing waves are not set up.

"In case still smaller areas are to be examined or if very small flaws or holes are to be found, the same technique of sending out a very short wave group may be employed and reflections from the defective area observed instead of transmission through the area. Under favorable conditions where the plate is fairly thick, a flaw as small as 0.010 in. in diameter can be detected by this technique.

"The supersonic method does not test the strength of a bond except insofar as variations of density, elasticity, or continuity may be present which of themselves influence the strength; the supersonic test merely indicates variations in density, elasticity, or continuity.

"Equipment for supersonic testing either with continuous waves or with short wave groups is manufactured by Sperry Products Co., Inc., 1505 Willow Avenue, Hoboken, New Jersey."

The Crystal Research Laboratories, 29 Allyn Street, Hartford, Connecticut, manufacture ultrasonic equipment and have done considerable research in connection therewith. This company was contacted to learn whether they had attempted to apply the supersonic method to the testing of bond strength. A part of the reply is included below.

"Our experience within this field has been confined to observations made in the course of development of our ultrasonic equipment, and we have never attempted any experiments directly along these lines. We have observed, for example, that the copper or silver electrodes plated on our crystals are sometimes shaken off by the intense agitation at ultrasonic frequencies. The work of Claus (*our refs. 137 and 138*) on the preparation of finely divided metallic powders by ultrasonic irradiation of a cathode during electrodeposition, depends essentially on the lowered adhesion of the deposited metal and suggests very strongly the possibility of developing an instrument suitable for measuring adhesion.

"It should not be surprising that an ultrasonic field should tend to detach an adherent coating when the magnitude of the forces acting on a vibrating system at resonance are considered. Bergman (*our ref. 139*) has given an estimate of the forces that are involved. The magnitude of the acceleration is given by the formula:

$$a_{max} = 4\pi^2 N^2 A$$

where a_{max} = acceleration in cm/sec^2
N = frequency in cycles per sec.
A = amplitude in cm

"With $N = 500{,}000$ cycles per second and $A = 10^{-5}$ cm, the order of magnitude of the displacements encountered in ultrasonic work, a_{max} is about 10^8 cm/^{2}, i.e. about 100,000 times the acceleration by gravity. Forces of such magnitude, properly applied to a metallic coating, should have a strong tendency to tear it loose."

The Brush Development Company, 3405 Perkins Avenue, Cleveland 14, Ohio, is engaged in developmental work involving supersonics as a method for measuring bond strength. A part of its reply is given here.

"At the present time, we are conducting a similar research program using various samples that have been forwarded to us by individual companies. Inasmuch as our results are not as yet conclusive, we do not have any papers or information to be passed on; however, as soon as information is available, we shall be very glad to send you a copy of our reports."

In a research project carried out in the Physics Department of the University of Michigan by Julian R. Frederick, the supersonic method was applied to the determination of bond strength. This work is so pertinent that Frederick was asked to submit a description of the equipment, the methods and the general nature of the results. His report follows:

"Some qualitative experiments with the use of a continuous beam of supersonic waves to test bond have been carried out. From the limited work, it was concluded that the method would readily detect absence of bond, but further investigation would be necessary to determine whether or not the strength of the bond could be measured.

"The method involved sending a continuous beam of supersonic waves into the part and measuring its intensity as it came out on the other side. Lack of bond caused a drop in the intensity of the transmitted beam because the waves were reflected by any sharp dis-continuity in the elastic properties of the transmitting medium.

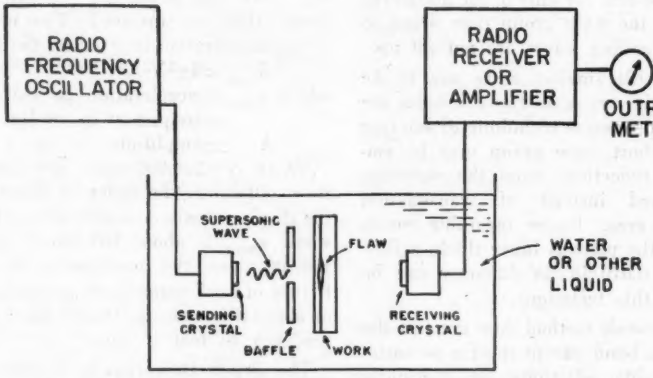


Fig. 13. Arrangement of apparatus to test bond by means of beam of supersonic waves.

"The arrangement of the apparatus is shown in Fig. 1 (*our Fig. 13*). All testing had to be done with the work immersed in a liquid such as water or oil, since air is an extremely poor transmitter of supersonic waves. The source of the waves was a piezoelectric quartz crystal which was electrically driven by a suitable radio frequency oscillator tuned to the natural frequency of the crystal. The receiving crystal was connected to an amplifier which consisted of an ordinary radio receiver with a slightly modified output circuit. The signal from the amplifier was measured on a decibel meter.

"In setting up the equipment, care had to be taken that the sending part of the system was completely shielded electrically from the receiving part, otherwise only part of the signal from the amplifier would have been due to the supersonic energy picked up by the receiving crystal and part a spurious electrical signal.

"Another problem was caused by standing waves that were set up in the acoustical part of the system. Since they can occur most easily between any two parallel surfaces in the path of the beam, it was advantageous to place the surfaces of the part being tested at an angle to the surfaces of the crystals. Another solution to the problem might have been to "warble" the frequency of the supersonic beam, but that would have required a different and more complicated system than the one mentioned above.

"Where it was not convenient to immerse the part completely in a tank of liquid, the beam of supersonic waves was shot down a stream of water which impinged onto the article from a specially designed nozzle. Similarly the supersonic beam was picked off the other side of the part by another stream of water.

"Tests were made on three different types of articles: 1/32 inch thick bimetallic sheet of the kind used in thermostatic control elements, aircraft engine bearings of silver electroplated on a steel base about 3¼ inch in diameter, and sintered metal deposits on a steel plate.

"Verification of the results of the supersonic tests in the experiments described below was made as follows: bond between two sheets of metal was assumed to be good if sharp bending of the material did not cause separation; on materials that could not be bent easily, a chisel was used to

determine the quality of the bond.

"The bonding in bimetallic sheet was attested successfully at frequencies of 1, 5 and 10 megacycles, both with the tank and with the running water techniques. The actual area inspected at any instant was about ¼ inch in diameter and it was necessary for the flaw to cover about one-third of this area before an appreciable drop in the output meter could be observed. Usually, however, the regions of discontinuity covered several square inches and no transmission of the supersonic waves was observed through them.

"The aircraft bearings were tested by immersing them in oil and sending a beam of supersonic waves from the inside to the outside surface. A baffle plate close to the bearing allowed only a wave beam ¼ inch in diameter to reach the receiving crystal, thus permitting detection of defects of about one-third that size. By a suitable jig arrangement, the bond over the whole bearing could be scanned. Only 1 and 5 megacycles were tried, but both frequencies were able to pick out defective areas.

"Only one test was made to determine the bond between a sintered deposit and the base metal. The sintered metal was about 1/16 inch and the steel base plate ⅛ inch thick. Different regions were deliberately made with poor bond, and these were accurately shown in the test by a decrease in the intensity of the supersonic waves passing through the plate.

"These investigations were carried on as a part of a research project for the Sperry Products Co., Inc., of Hoboken, N. J., which manufactures equipment for supersonic testing."

Probably the most thorough practical investigation of the use of the supersonic method for testing bond strength on a commercial basis was made by Frank D. Hallworth, Engineer, Materials Development Laboratory, Pratt & Whitney Aircraft Division, United Aircraft Corporation. This work was done in connection with the very extensive use of silver plated steel bearings in aircraft engines during the recent war.

The results of the studies of the supersonic and other methods were presented on December 5, 1945, before the Southern New England Section of the Society of Automotive Engineers. A copy of the report [140] was recently forwarded to me with the privilege of quoting any desired portions in this paper. Because of the interest shown in the supersonic method and the exceptional nature of the work done by Hallworth on this and other interesting methods, his paper is extensively quoted here:

"For heavy duty applications where high loads, high temperatures and high surface speeds are encountered, the silver plated steel bearing has established an excellent service record in aircraft engines. Plated with a thin layer of lead and indium to improve its performance, it is used as a bearing for crankshafts, master rods and other highly stressed parts. Because of its excellent anti-galling properties, a thin silver plate is used on articulated rod pins, tappet roller pins and other closely fitted parts. The critical nature of all these parts makes it extremely important that the silver adhere strongly to the steel back. Failure to do so can result in complete breakdown of an engine.

"Even with the most carefully controlled production electroplating processes, poorly bonded silver occasionally occurs. The defective area may be small, or it may extend over the entire plated surface. Such a condition can be caused by improper cleaning or etching prior to plating, failure to connect the current source to the part before immersion in the plating bath, or any of a number of other reasons. Although the percentage of defective parts is normally low, the high standard of quality regularly maintained in aircraft engines requires that non-destructive inspection for bond be performed on every silver plated part. The methods used must test the entire plated surface, experience having shown that small areas with poor adhesion may occur at random on a part, most of which has good silver adhesion.

"Over a period of four years, a number of inspection methods which vary in effectiveness and adaptability have been developed for testing silver bond. These can be divided into two classes: methods which can be used on a finished part and methods which can be used only on semi-finished parts. In the first group are the Supersonic Pulse Method, the Fluorescent Penetrant Oil Method and the Whirl Test. The second group includes the Shear Test, the Roll-Peen Test and the Shot-Peen Test.

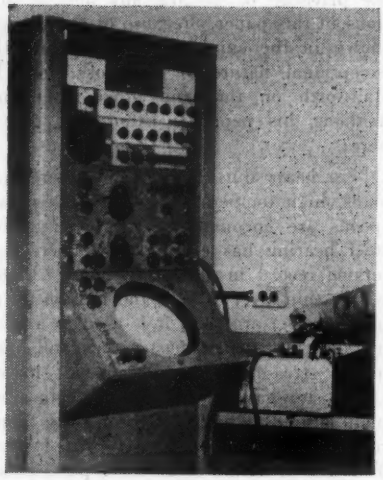


Fig. 14. While rotating bearing mounted in oil-submerged scanning jig, operator observes patterns on supersonic reflectroscope oscillograph.

"The first device used by Pratt & Whitney Aircraft for silver bond inspection was the Supersonic Reflectoscope (Figure 1), (*our Fig. 14*) invented by Dr. F. A. Firestone [1, 2] (*our refs. 135* and *136*) of the University of Michigan. This complex electronic unit produces pulses of high frequency current which are applied to the faces of an X-cut quartz crystal. The crystal, ground to fit the curvature of the bearing and separated from it by a thin film of oil, radiates corresponding pulses of supersonic vibrations into the plate. If the plate is in contact with the steel back, the pulse passes from the silver into the steel, thence to the opposite surface, where it is reflected back over the same path to the crystal. If the silver is slightly separated from the steel back, the pulse is either reflected or dispersed at the gap (Fig. 2) (*our Fig. 15*). By observing the amplitude and shape of the pattern on the cathode ray tube screen as the crystal is passed over the plated surface, the operator differentiates between areas of good and bad bond (Figure 3) (*our Fig. 16*).

During the two years that this method was used for routine inspection by Pratt & Whitney Aircraft, certain limiting features of the Reflectoscope became apparent. The device is sensitive to slight depressions and roughness in the plated surface, to microporosity in the silver, and to inclusions in the steel back, all of which give screen patterns similar to that produced by bad bond. Most important of all, it detects lack of adhesion only when an actual gap exists between the plate and the steel back, a condition which may not be present even though there is a complete lack of bond. For these reasons, the Supersonic Reflectoscope did not prove a completely adequate inspection device for silver bond and was superseded by later methods."

In a second private communication, [140] additional pertinent information was given and is included below:

"Most of the work done to date has been at a frequency of 5 megacycles per second using longitudinal waves. It may be that a much higher or lower frequency may be more effective. We know from our experience in supersonically testing large sections of steel for internal flaws, that the sensitivity is a function of the wave length of the supersonic vibrations used. The ratio between the length of the sound wave and the dimensions of the internal flaw must be high if the flaw is to have much effect on the wave train. We have tried frequencies up to 11 megacycles without much success. Further study is necessary before the limitations of supersonic bond testing can be definitely established.

"The Reflectoscope is an exceedingly complex device requiring a trained technician to operate it and to interpret its results. A precision jig must be used to hold the part being tested. It is a slow test in that the entire plated surface must be carefully scanned."

The paper by Hallworth also contains reports on studies of other methods. Some of the more pertinent remarks are given below.

The Black Light Test

One of the methods discussed [140] is commonly known as the "Black Light" or "Fluorescent" method; he designated it as the "Fluorescent Penetrant Method". The usual test procedure is followed. The following precaution is suggested:

"Under 'black light', the released oil fluoresces and appears as a sharp, bright line at the edge of the bad bond area (Fig-

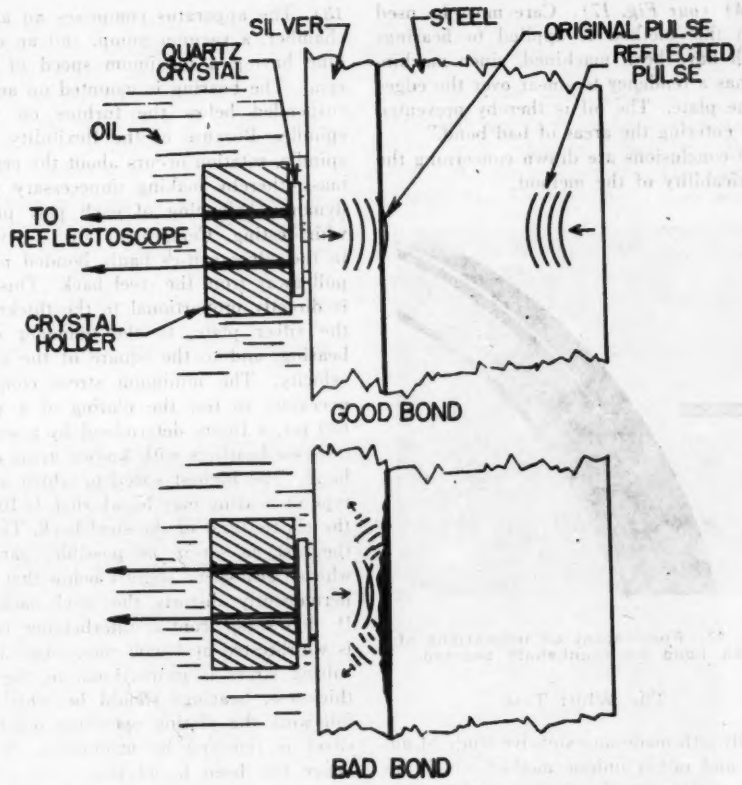


Fig. 15. Supersonic pulses are dispersed by bad bond but pass readily through good bond.

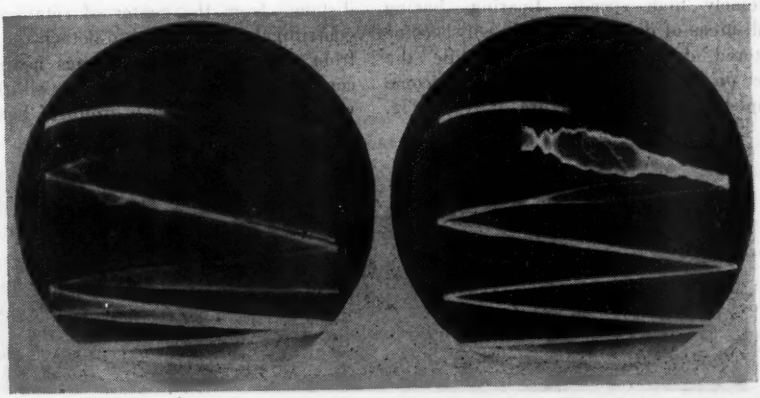


Fig. 16. Reflectroscope oscillograph screen patterns: left—good bond, right—bad bond.

ure 4) (*our Fig. 17*). Care must be used when this method is applied to bearings which have been machined, since machining has a tendency to smear over the edges of the plate. The oil is thereby prevented from entering the areas of bad bond."

No conclusions are drawn concerning the practicability of the method.

Fig. 17. Fluorescent oil indications of bad bond on crankshaft bearing.

The Whirl Test

Hallworth made an extensive study of another and rather unique method which appears to offer possibilities in special cases, at least in research work and even industrially. He calls it the "Whirl Test". His remarks concerning this test follow [140]:

"The Whirl Test consists of spinning an externally plated bearing about its axis at extremely high speeds. Bearings having small areas of defective plating will become blistered during whirl-testing while the silver on larger defective areas will become completely detached (Figure 5) (*our Fig. 18*). The apparatus comprises an armored chamber, a vacuum pump, and an air turbine having a maximum speed of 60,000 rpm. The bearing is mounted on an arbor suspended below the turbine on a thin spindle. Because of the flexibility of the spindle, rotation occurs about the center of mass, thereby making unnecessary precise dynamic balancing of each part prior to whirl-testing. Centrifugal stress developed in the silver causes badly bonded plate to pull away from the steel back. This stress is directly proportional to the thickness of the silver plate, to the diameter of the bearing, and to the square of the angular velocity. The minimum stress considered necessary to test the plating of a part is 600 psi, a figure determined by a series of tests on bearings with known areas of bad bond. The highest speed to which a given type of bearing may be whirled, is fixed by the elastic limit of the steel back. To make the test as severe as possible, parts are whirled at a speed slightly below that which permanently distorts the steel back. The Double Wasp front counterbalance bearing is whirl-tested at 40,000 rpm. Since the resulting stress is proportional to the silver thickness, bearings should be whirl-tested following the plating operation before any silver is removed by machining. No evidence has been found that good bond is adversely affected by this test, even at speeds which permanently deform the steel back.

"To whirl-test bearings which are plated internally, a turbine arbor was made in which several bearings were mounted at a distance from the center of rotation. The centrifugal force tended to detach the silver from the sides of the bearings nearer the center of rotation. At least two whirl tests were necessary for each group of bearings,

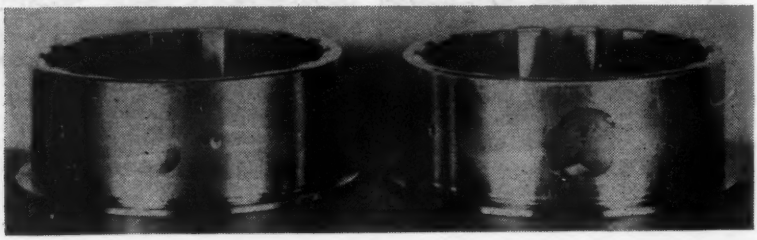


Fig. 18. Defective Double Wasp front counterbalance bearings after whirl testing at 40,000 rpm.

the bearings being indexed between runs. Difficulties were encountered in whirling the massive arbor and in protecting the equipment in the event of a bond failure. Because other methods of checking inside plating became available, development of this type of arbor was suspended.

"Although whirling is a practical production test method and has been in use for some time, its production rate is low because of the time required to accelerate to the high test speeds. Also, failure of the silver on a bearing under test at these speeds may result in damage to the turbine or spindle.

before this technique can be used in production whirl-testing."

The Chisel Test

Hallworth describes an interesting variation of the well known Chisel Test which he calls the Shear Test [140]. The picture in Figure 11 (*our Fig. 20*) is very revealing.

"The Shear Test is a fast, economical method for checking bond of silver at the edge of an as-plated part. The bearing to be tested is held in a jig and a blunt chisel forced against the overhanging edge of the plate.

Fig. 19. Brittle lacquer coated bearing after 12,000 rpm whirl test. Lacquer has cracked over area of badly bonded silver in center of bearing.

"With a brittle lacquer sprayed on the bearing prior to whirl-testing, it has been found that successful testing can be carried out at lower speeds. When the lacquered bearing is whirled at low speed, the silver on a badly bonded area lifts slightly causing the lacquer to crack (Figure 10) (*our Fig. 19*). Without the lacquer, it is necessary to whirl the same bearing approximately three times faster to produce an actual silver blister. Unfortunately, available brittle lacquers are quite sensitive to oil, fingerprints, and changes in atmospheric humidity, and require a twenty-four hour drying period. The development of a stable, quick-drying lacquer is necessary

"The silver should be of sufficient thickness (0.008 to 0.010 inch) to provide stiffness so that a relatively large force can be applied to the silver before it is sheared. Because the chisel scratches the steel back, shear testing is suitable only for semi-finished parts."

The Roll Test

There are several devices described in the literature which in one way or another make use of the basic principle of shearing. Hallworth [140] describes one variant which he calls the "Roll Test". Its applications are distinctly limited, but it should be high-

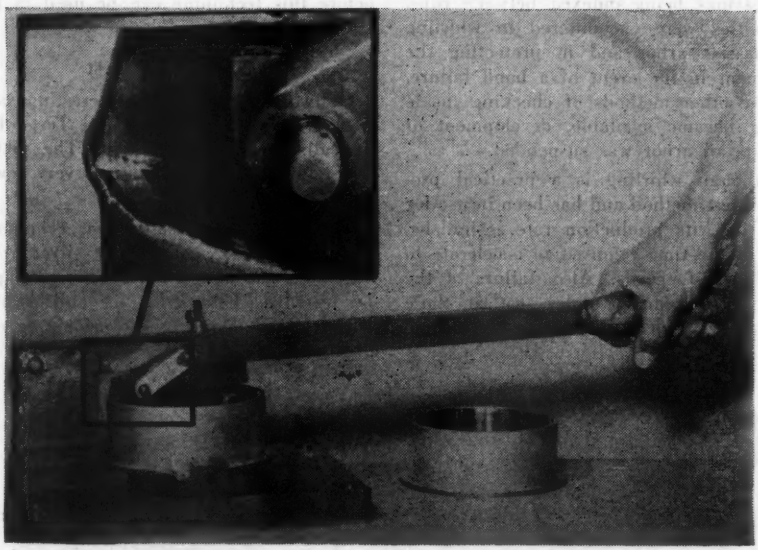


Fig. 20. Shear testing a front counterbalance bearing. Inset shows appearance of defectively bonded silver.

ly effective on some parts. His remarks follow:

"Roll testing is essentially a roll peening operation suitable for use on semi-finished cylindrical parts. The device was developed by the Ford Motor Company for testing Double Wasp articulated rod pins. The pin is rotated between three rolls, two of which are power driven (Figure 12) (*our Fig. 21*). By means of weights and a lever system, the third roll applies pressure to the part. After a thirty-second test, small areas of poor bond will appear as shiny smears or as broken blisters, while larger areas may be completely torn off the steel back (Figure 13) (*our Fig. 22*). The roll test has been used successfully on articulated rod pins, valve tappet roller pins, and counterbalance bearings."

The Shot Impingment Test

There are several tests for adhesion which in one way or another make use of a peening operation. One of the most recent variants which has aroused much interest is the "BNF Adhesion Test" developed by A. W. Hothersall and C. J. Leadbeater [130]. Considerable attention was given to this test in an earlier report on this project.

Hothersall and Leadbeater [130] also describe a variant which they call the "Shot Impingement Test". Because of an increasing interest in this test and the high opinion expressed by Hallworth of a similar method extensively studied by him (to be presented later), the work of Hothersall and Leadbeater is included here:

"Two forms of this test have been developed. In the first, a stream of shot was allowed to fall by gravity on the surface of the specimen.

"The following apparatus and methods are given by way of example:—

"1. Two pounds of iron or steel balls (diameter 0.065 inch), for example chilled iron shot of the type commonly used for 'shot-blasting', were placed in a reservoir to which was fixed an outlet in the form of a tube, 24 inch long with ¼ inch internal bore. The shot was allowed to fall on the surface of the component to be tested. The open end of the tube was fixed at a distance of about ¼ inch from the specimen. The reservoir, tube and specimen formed an integral part of a container, in which the specimen was fixed, so that the spent shot were easily recovered for further use.

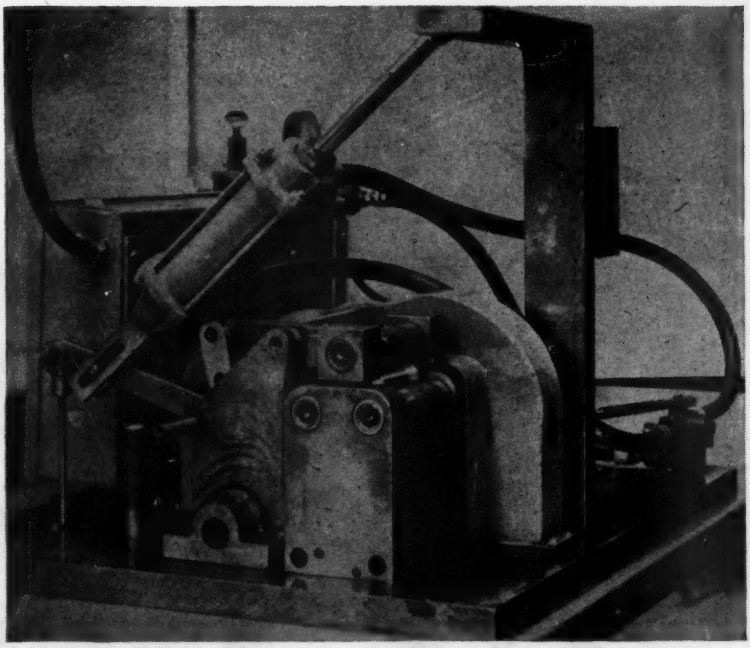


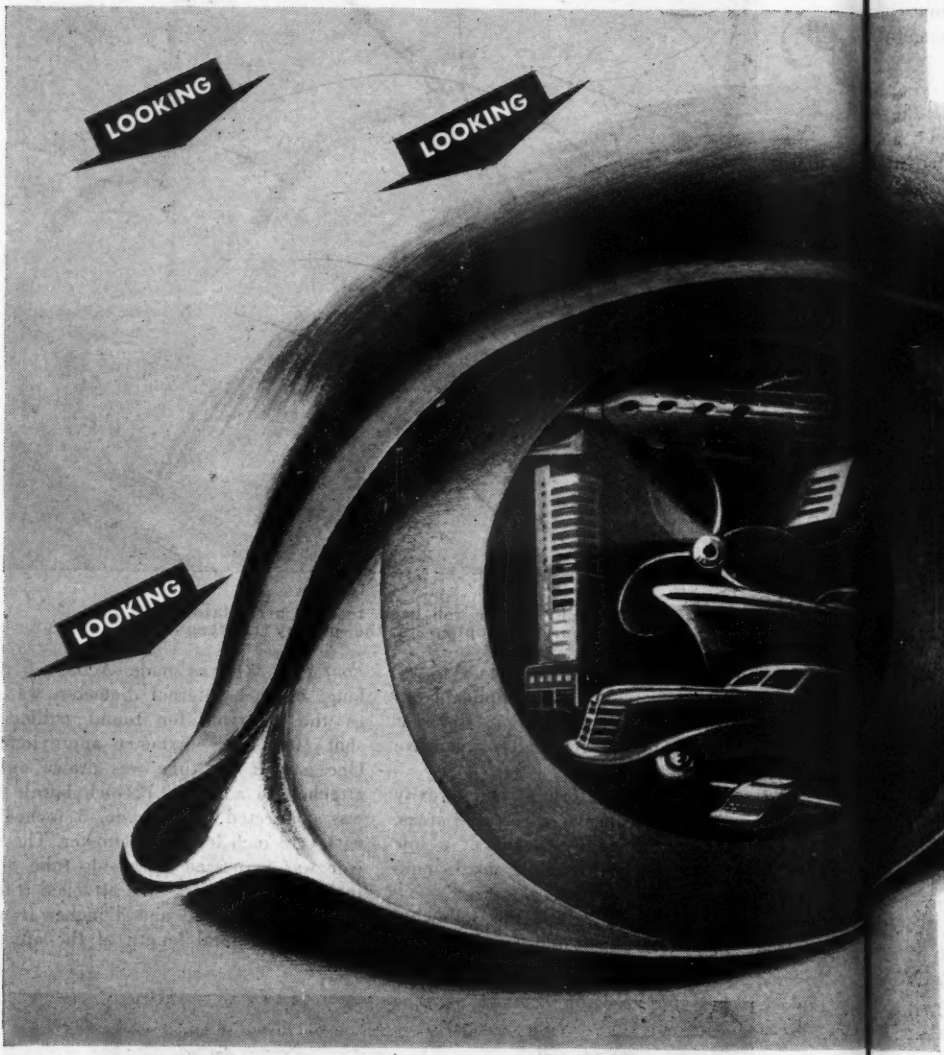
Fig. 21. Roll rig for roll-peen testing articulated rod pins. Pressure is applied to the pin by the top roll.

"This apparatus was simple, easy to assemble and cheap, and was applicable to flat or convex surfaces, but it was not readily applicable to recessed or concave surfaces.

"2. In a modified form of the gravity test applicable to concave or recessed areas, the shot were forced by means of a low pressure air stream through a nozzle onto the surface to be tested.

"After preliminary trials, the following glass apparatus, illustrated in Figure 8 (*our Fig. 23*) was made. A tube, 6 inches long, ¾ inch internal diameter, was used as the reservoir for round chilled iron shot (0.03 inch diameter approximately). One end of the tube was drawn out and attached to a tap (0.12 inch bore) which was connected to a nozzle, 3 inches long with 0.13 inch internal diameter. The reservoir was by-passed by a side tube of 0.12 inch diameter which was attached 3 inches from the open end and 3 inches from the nozzle. The total length of the apparatus

Fig. 22. Roll tested articulated rod pins having badly bonded silver.



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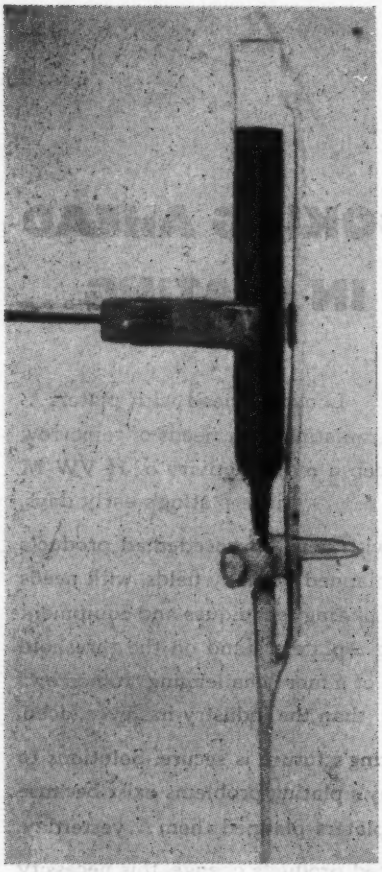

Fig. 23. Model of gun used for shot impingement test.

was 11 inches. Figure 9 (*our Fig. 24*) shows the apparatus assembled ready for testing. The specimen was held by means of a universal clamp in a cylindrical glass vessel (e.g., a 5-litre battery jar) which was covered by a metal plate lined with crepe rubber. The pistol was inserted through a hole in the cover plate and clamped with the nozzle near the specimen under test. Compressed air was brought to the apparatus through a rubber connection which was also connected to a pressure gauge. The reservoir was loaded with 125 grams of chilled iron shot.

"The process of testing consisted in loading the reservoir with shot, connecting the air-blast to the reservoir, and then releasing the shot by opening the tap at the base of the reservoir. The by-pass tube provided an outlet for the air before the tap was opened; the stream of air emerging from it served to increase the momentum of the shot.

"Tests to determine the effect of varying the air pressure and the distance of the nozzle from the specimen were made on a piece of brass plated with a poorly adherent nickel coating, 0.0005 inch in thickness. Blisters which were readily visible were obtained with air pressures of 1-3 psi and with distances between nozzle and specimen of ⅛-½ inch. With too high a pressure, the basis metal was completely denuded of deposit, while with too low a pressure, blisters did not form with the one charge of shot. With a pressure of 1-2 psi, the test could be performed in about two minutes.

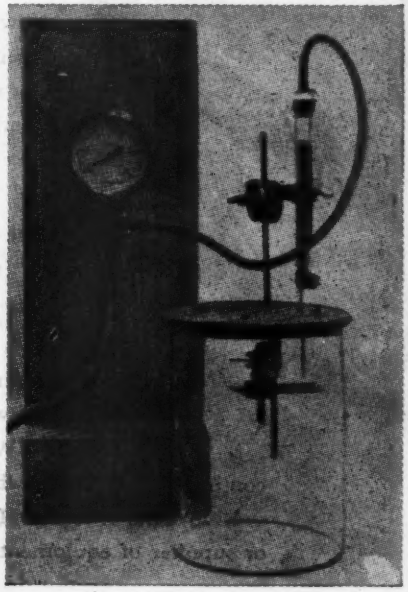

Fig. 24. Complete model of shot impingement test.

"The test was applied to a number of plated articles having coatings which were known from other tests to be poorly adherent. The basis metals were spring steel, medium carbon steel, brass and magnesium alloy. Satisfactory evidence of poor adhesion was obtained with all the speci-

Fig. 25. Nickel on steel blistered by (a) shot impinging test, (b) B.N.F. adhesion test.

mens. A typical result is shown in Figure 10 (*our Fig. 25*).

"The shot impingement test has the disadvantage of requiring a supply of compressed air and involving difficulties in the collection of the steel shot when large objects are being tested. Thus, while giving the desired result, it appeared to be less suitable for general use than the BNF Adhesion Test described in this report."

The Shot-Peen Variant

As developed by Hothersall and Leadbeater, the shot impingement test is applicable only to thin deposits on which it is successful in indicating a complete lack of bond. The same principle was used by Hallworth in one of the methods which he developed for testing thick deposits. His variant, which he calls the "Shot-Peen Test", proved so successful that it is presented here in considerable detail. It is interesting to note, however, that he makes no claims for the method except in the complete absence of bond. He stated [140]:

"Shot-peen testing is one of the most recent methods devised for checking silver plate adhesion. In England, A. W. Hothersall and C. J. Leadbeater [3,4] (*our ref. 130*) first used the method for spot testing very thin plates (0.0001-0.002 inch). Their apparatus, however, was not at all adaptable to heavy plates or to continuous production inspection. The test was further developed at Pratt & Whitney Aircraft for production inspection of plates up to 0.025 inch thick. At this writing, it appears to be the most adaptable test available for checking silver adhesion.

"The principle involved in the peen test is that the hammering action of the shot produces deformation of the silver. If the silver is poorly bonded and, therefore, unrestrained by the steel back, it will extend or flow and become blistered (Figures 14 and 15) (*our Figs. 26 and 27*). The intensity of peening necessary to cause non-

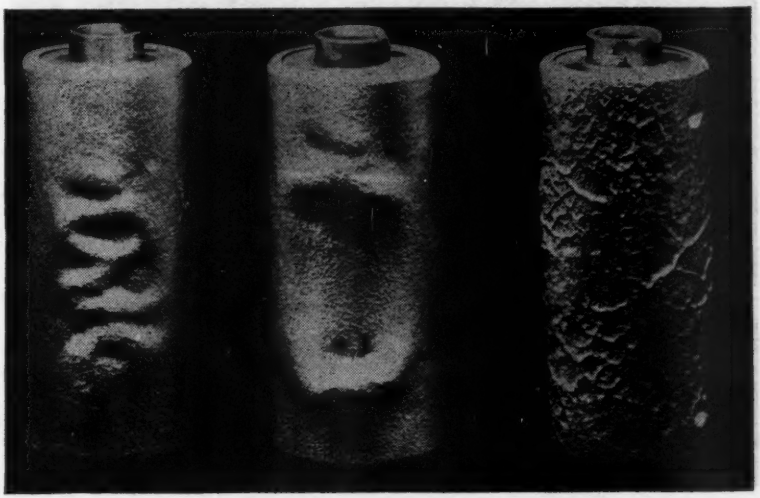

Fig. 26. Shot-peen tested articulated rod pins with defectively bonded silver plate.

adherent silver to blister varies with the plate thickness, thin plates requiring less than thick plates. Figure 16 (*not shown here*) shows the approximate intensity required to raise blisters on silver plated steel where the adhesion is slight. Standard Almen "A" strips are used to measure the peening intensity (*our ref. 141*).

"Parts are peen tested in a standard air operated cabinet of the type used for shot-peening steel engine parts. Although glass beads, sand, and steel shot were effective in revealing lack of adhesion of plate, best results have been obtained with malleable iron shot. Masking is necessary to prevent peening of the unplated areas, and small oil holes must be plugged to keep shot from jamming in the holes. The shot should be kept clean and free from broken particles which may become imbedded in the silver.

"The effects of peen testing a silver plated bearing are two-fold: (1) the silver surface becomes a region of small peaks and craters (Figure 17) (*our Fig. 28*), and (2) slight work-hardening occurs to a depth of several thousandths of an inch.

"Parts are shot-peen tested following the plating operation, in which customary practice has always been to electroplate silver at least 60% thicker than the finished

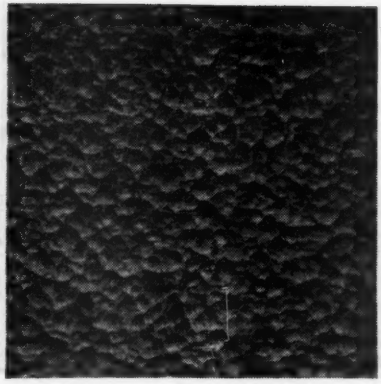

Fig. 28. Appearance of surface of shot-peen tested silver plate. About 100x.

dimensions require. The surplus silver is removed when the bearing is machined to size. For example, a counterbalance bearing plated with 0.021 inch silver would have 0.010 inch silver machined off during finishing operations, more than enough to insure the elimination of all surface roughness and most of the work-hardened layer caused by peening. Shot-peening is the most adaptable of all the methods described in this paper, in that it may be used to test the entire silver plated surface of any part

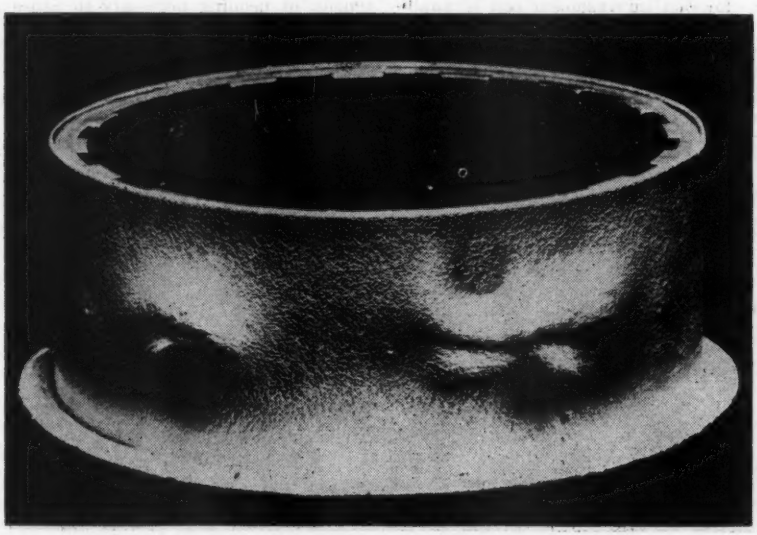

Fig. 27. Shot-peen tested Double Wasp front counterbalance bearing with two areas of bad bond.

regardless of its size or shape, provided only that the surface can be reached by a stream of air propelled shot. It is, however, limited to use on semi-finished parts. No investigation has been made of its effectiveness under any condition other than complete lack of bond."

Other Tests

Hallworth [140] makes the following interesting remarks concerning other methods:

"A number of other testing methods have been tried with little success. On the theory that a drop in silver resilience might accompany a bad bond condition, a series of tests were made with the Scleroscope. No correlation was found. Recently, however, another laboratory has reported some success in testing adhesion of babbitt by measuring the rebound stress in an air-operated repeating hammer. Physical properties, unsuccessfully utilized in an endeavor to find improved adhesion tests, include cross sectional electrical resistance, thermal conductivity, and differential thermal expansion and contraction."

Final Conclusion

To me the final conclusion of Hallworth, based upon his extensive laboratory search, concerning the ideal method for measuring bond strength and the practical value of methods for specific purposes, is most interesting. It is the same conclusion that I have reached as a result of my extensive survey of the published literature and the personal experiences of those actively engaged in the plating industry.

The conclusion of Hallworth [140] follows:

"The ideal bond testing method which instantly and non-destructively indicates adhesive strength has not yet been devised. However, by use of the methods outlined, silver plated engine parts can be produced with assurance that those which pass the test will give satisfactory performance."

ACKNOWLEDGMENT

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One feature of this report is the extensive use of direct quotations from the published literature. This makes it unnecessary for the reader to look up the original references. The literature search is so extensive and complete that the future worker in the field can begin where the report ends.

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BOOK REVIEWS

By DR. HAROLD J. READ
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DICTIONARY OF METAL FINISHING CHEMICALS by Nathaniel Hall and G. B. Hogaboom, Jr., IV + 129 pages. Metal Industry Publishing Company, 11 West 42nd St., New York 18, N. Y.

This little volume is a chemical dictionary in the traditional style, that is, elements, compounds and naturally occurring substances are listed alphabetically and identified by formula, molecular weight and a few physical properties. Numerous cross-references tie together the common, uncommon and scientific names of the various substances listed.

The preface would lead one to expect somewhat more since it is stated that "In addition to the common names, it was considered desirable to include additional data, in connection with the chemicals listed, for the purposes of identification and determination of reactions". For the latter purposes, the data found in the book are entirely inadequate.

With regard to its prime purpose of clarifying chemical terminology for the plater and relating common names to scientific names, the dictionary is reasonably satisfactory although there are occasional errors and discrepancies, particularly in specific gravities of liquids. It is unfortunate, for example, that the common mistake in naming $Na_2S_2O_4.2H_2O$ is repeated. This compound should be called sodium hyposulfite, not sodium hydrosulfite. Spot checking revealed that coverage of chemicals which might conceivably be used by the plater is very complete, but it also showed a rather considerable number of minor and unimportant errors. On the whole, however, the practical plater should find the book quite useful in interpreting formulae, ordering supplies, etc.

The nicely printed and well-bound volume includes specific gravity tables for several of the more common acids, bases and salts.

METALLIZING NON-CONDUCTORS by Samuel Wein, 62 pages. Metal Industry Publishing Co., 11 West 42nd St., New York 18, N. Y.

The compilation of a complete bibliography on the subject of metallizing non-conductors is a task of no small magnitude, and the author of this short monograph is to be congratulated on the extent and apparent completeness of his references to some aspects of the subject.

The text based upon this literature search is divided into chapters on historical background and general discussion, mechanical films, chemical reduction films, cathode sputtering and metal spraying, metallic paints and finally, plating. The electroplater may be disappointed to find that the last chapter is but one and a half pages long. The section on cathode sputtering and metal spraying is also quite brief, and contains little of interest to the practical worker. The chapter on metallic paints refers to processes involving the firing of the work, and hence is of interest to those dealing with ceramic bodies.

The twenty-five pages on chemical reduction films make up the most interesting

(*Continued on page* 671)

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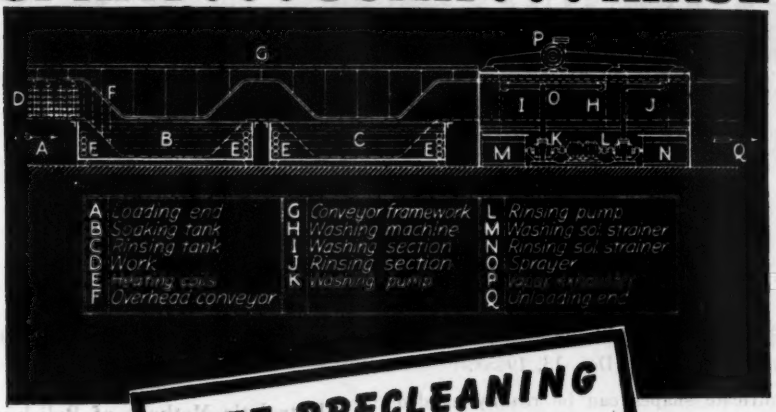

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Electrodeposition of Metals on Plastics

Iron Age **156**, 58 (Dec. 13, 1945).

Intricate shapes can be readily molded and electroplated than fabricated in metal and electroplated. As the weight added by application of metal to the plastic is usually negligible, plated plastic part still maintains weight advantage over a similar part made of metal.

Metals on Plastics

H. NARCUS. *Metal Industry* **67**, 342-344 (Nov. 23, 1945).

Review of electrodeposition processes.

Brass Plating for Rubber-to-Metal Adhesion

Steel **117**, 115, 118 (Dec. 24, 1945).

Conditions affecting the application of the process and methods for control are reviewed. Four references.

Corrosion Protection of Steel Pipe by Resin Baking Coatings

ROBERT J. MOORE. *National Petroleum News* **37**, R-992-4 (Dec. 5, 1945).

Induction heating is used to solve problems in the application of phenolic resins.

Wire Galvanizing—Herman Process

ROWLAND HUSSEY. *Wire & Wire Products* **20**, 927-931 (1945).

Description of a comparatively new hot dip method of applying zinc to carbon steel wire.

Electrolytic Methods of Polishing Metals X

S. WERNICK. *Sheet Metal Ind.* **22**, 1951-1958 (1945).

Electrolytic polishing of carbon steels. Ten references.

What's Ahead in Product Finishes

BURR PRICE. *Products Finishing* **10**, 90, 92, 94, 96 (Dec. 1945).

Abstracts of proceedings of "Convention-at-Home" of the National Paint, Varnish and Lacquer Association. Rapid product finishes, infra-red drying, induction heating, coatings for container interiors, prevention of corrosion, and metal finishes for aircraft are discussed.

Selection of Cooling Coils

GEORGE K. MARSHALL. *Heating & Ventilating* **42**, 82-87 (Nov. 1945).

Method of calculation and selection of cooling coils for various applications.

Speculum Plating and Its Uses

JOHN IRELAND. *Materials & Methods* **22**, 1400-1402 (1945).

Chemical composition of the deposit is about 45 per cent tin and 55 per cent cop-

per, and the properties of the alloy coating are quite different from either of the constituent metals. The coating has the color of silver, its hardness is intermediate between that of nickel and chromium, and its resistance to corrosion and tarnish is high.

Control of Porosity in Aluminum Alloy Pistons

Light Metal Age **3**, 16-20, 38-39 (Nov. 1945).

Investigations in a large aluminum foundry into various factors contributing to porosity in aluminum castings are described. Recommendations are made as to foundry practice to eliminate the causes. Two references.

The Cause and Control of Microporosity in Magnesium Alloys

E. A. G. LIDDIARD and W. A. BAKER. *Foundry Trade J.* **77**, 205-207 (1945).

Discussion of a paper presented at the annual meeting of the Institute of British Foundrymen, printed in Oct. 25 and Nov. 1 issues.

The Scaling Properties of Steels

Ind. Heating **12**, 2118, 2120 (Dec. 1945).

Scaling characteristics of a number of steels in furnace atmospheres at 1150°C (2102°F) are described.

Current Zinc Electroplating Practice

ALLEN G. GRAY. *Steel* **117**, 132, 134, 136 (Nov. 12, 1945).

Phosphate, anodic and chromate types of protective coatings for zinc plated surfaces are discussed. Eleven references.

Increasing Fatigue Resistance by Shot Peening

Machinery (London) **67**, 449-454 (1945).

Shot-peening has increased the life of hypoid gears by as much as 600%; aircraft engine crankshafts, 900%; steering knuckles, 475%; welded joints, 310%; transmission main shafts, 520%; and helical springs, 1370%. The process consists in throwing shot on the work from a centrifugal wheel that revolves at high speed.

Patent Policy in the United States

S. MITTLER. *Chemical Age* **53**, 457-459 (Nov. 17, 1945).

Possible effects on British-owned patents.

A Protective Finish for Magnesium Alloys

R. B. MASON. *Iron Age* **157**, 48 (March 21, 1946).

After thorough cleaning of the part, it is anodized in a 5% sodium hydroxide solution at 150°F and 12-18 amp/sq.ft. for 30 minutes to obtain a thickness of approximately .0005 in. Following the electrolytic treatment, the part should be thoroughly rinsed, then sealed in a sodium chromate solution at 170-180°F for 30 minutes. Dichromates are unsuitable since anodic coatings are stripped in acid solutions.

Exposure results for variously treated AMC 265, AMC 52-S, and AMC-573 are shown. In every case the above treatment afforded adequate protection. The coating provides resistance to abrasion.

Precision Seamless Tubing by Electro Deposition

J. ALBIN. *Iron Age* **157**, 54 (Jan. 10, 1946).

Parts of identical dimensions with high interior surface finish in S-shapes, round or square tubes, tapers, rectangular or parabolic cross sections, are produced by electroforming with iron by the U. S. Rubber Company's Ecco Process for venturis, nozzles, injection system, radar horns and aircraft radio antennae. Finished parts may be combinations of nickel, copper or chromium together with iron, depending upon the requirements.

In the production of radar horns, a low melting point alloy is cast in a polished

steel mold. After removal, the cast matrix is highly finished and an iron electroform is made. The matrix is melted away, leaving a shell of iron with the surface finish of the matrix. The process is utilized in salvaging worn and undersized parts, such as Navy diesel cylinder liners. In some cases a porous chromium deposit was used in addition to the iron for maximum wear resistance.

Electrodeposited iron has a Brinell hardness of 225 but can be annealed to 140. Case hardening produces the characteristic pearlite structure of steel. Control of the special electrolyte makes possible continuous operation for as long as 4 or 5 years without shutdown.

Chromium Plated Tools for Longer Life

ANDREW A. SPISAK. *American Machinist* **90**, 99 (Feb. 28, 1946).

Through control of the thickness of the chromium plate and by proper normalization of the part before and after plating, excellent results were obtained by Warner and Swasey Company, machine tool manufacturers. The average tool life was increased by 400 per cent.

The process comprises alkaline electrocleaning, anodic treatment in the chromium plating solution, chromium plating and immersion in a hot oil bath for normalization after plating, which removes the hydrogen trapped within the metal.

Ventilation Requirements for Industrial Solvents I. Dilution Rates of Vapor

W. C. L. HEMEON. *Heating & Ventilating* **42**, 95-98 (Dec. 1945).

New and fundamental data for direct application to ventilation design problems is presented.

Corrosion of Steel Salt-Bath Pots by Molten Alkali Nitrates

R. J. BOX and B. A. MIDDLETON. *Eng. Digest* (Am. Ed.) **2**, 575 (1945).

Data based on observations during several years on the behavior of salt-bath furnaces in a group of factories.

Sea-Air Corrosion of Magnesium Alloys

J. A. PELOUBET. *Metals and Alloys* **21**, 1327-1333 (1945); *Metallurgia* **32**, 293-294 (1945).

The resistance of various magnesium alloys to seaside atmosphere is described.

The Value of Tin on a Can

W. R. LEWIS. *Tin and Its Uses* **16**, 5-7 (Sept. 1945).

Efforts have been made to use thinly coated electrolytic tinplate and lacquered blackplate as substitutes for hot-dipped tinplate. Experience indicates that the utility of lacquered blackplate is limited and that cans made from thinly coated tinplate must be lacquered inside and outside to approach the performance of plain hot-dipped tinplate cans. Four references.

Lengthening the Life of Painted Steel

Tin and Its Uses. **16**, 3-4 (Sept. 1945).

A very thin coating of tin provides considerably greater immunity to rusting and, in many cases, may be more convenient and cheaper to apply than a phosphate coating.

Marine Corrosion and Erosion

J. W. DONALDSON. *Metal Treatment* **12**, 159-170 (1945).

Raft tests, anti-fouling investigation, anti-corrosive compositions for underwater service, galvanic corrosion, paint tests, and cavitation erosion are covered. Sixteen references.

The Comparator—Modern Gaging Instrument

Screw Machine Eng. **7**, 47-56 (Dec. 1945).

Measurement by interception of light beams; control of quality in manufacture; setting up control; measurement and comparison; horizontal, vertical and angle measurements; comparator as a companion tool to thread grinding and allied threading processes are discussed.

Lubrication

HENRY VITA. *Metal Ind.* **67**, 341 (1945).

Recommendations for lubrication in forging and stamping of aluminum alloys.

Lubrication in Drawing Aluminum

SAMUEL SPRING. *Steel* **117**, 78-79, 98-101 (Dec. 24, 1945).

Frictional characteristics of aluminum during drawing frequently result in loading or fouling of tools despite the small force required for plastic deformation of many alloys. Various combinations of lubricants are used to alleviate this tendency, as well as tool design for minimizing ironing and other factors. Nineteen references.

Magnesium-Copper Sulphide Rectifier Design Factors

R. O. WHITESELL. *Electrical Mfg.* **36**, 106-109, 190, 192, 194, 196 (Dec. 1945).

Operating characteristics of the magnesium-copper sulphide type of dry disk rectifier are described and engineering design factors are offered the electrical designer for use in preparing his complete product.

Soft Solder Selection Aided by Simple Test

E. E. SCHUMACHER, G. M. BOUTON and G. S. PHIPPS. *Materials & Methods* **22**, 1407-1410 (Nov. 1945).

Method of testing wetting ability of soft solder. Five references.

Quality Control and Spot Welding

N. G. DOD. *Aircraft Production* **7**, 563-564 (Dec. 1945).

Application and value of statistical methods.

Resistance Welding Prior to Porcelain Enameling

CLYDE G. BASSLER. *Better Enameling* **16**, 8-9 (Nov. 1945).

Proper equipment and control in fabrication by welding are essential for good porcelain enameling.

Metallizing as a Production Process

Iron Age **156**, 72-73 (Dec. 13, 1945).

Various applications are described.

Statistical Methods in Quality Control VII

Elec. Eng. **64**, 448-450 (Dec. 1945).

Control charts for analysis of variables. Three references.

Corrosion as Encountered on Naval Aircraft and Methods of Prevention

Corrosion & Material Protection **2**, 9-12 (Dec. 1945).

Explains the "why" of rigid specification requirements for protection.

Preventing Surface Decarburization in Large Shaved Transmission Gears

E. G. DE CORIOLIS. *Iron Age* **156**, 56-61 (Nov. 29, 1945).

Methods and equipment are presented. The procedure involves several innovations, notably the use of bell type furnaces and cooling below 1000°F, before removal and subsequent hardening.

Electrodeposition of Alloys

I. General Considerations. R. Piontelli. **II. Nickel-cobalt Alloys from Sulphamic Acid Bath.** R. Piontelli and G. F. Patuzzi. *Met. ital.* **34**, 242-9 (1942); *C. A.* **38**, 3911 (1944).

Sulfamic acid baths containing equal concentration of Ni and Co at 40° C, 150 amp/sq. m. (14 amp/sq. ft.), pH 4-6 and strong stirring, gave pure Co deposits. When only 10% of the metal in the bath is Co, the deposit is an alloy containing 45-55% Co. With increasing pH, the Co content of the deposit decreases. With increasing current density, the Co content decreases, but at 80° C it increases with higher cd. This is ascribed to the lower overvoltage of nickel at high temperatures which facilitates the separation of alloys rather than that of pure metals. With increased stirring speed, the Co content of the alloy increases.

Ernest H. Lyons, Jr.

Phosphatizing in Localized Nitriding

S. F. YUR'EV. *Mettallurg.* **15**, No. 11/12, 44-8 (1940); *C. A.* **38**, 3235 (1944).

Trouble with tin melting and spreading to surfaces which are to be nitrided, may

be avoided by phosphatizing the article for 30-40 min. after the tin has been applied, because the melted tin will not wet a phosphatized surface. The phosphate layer does not interfere with nitriding, but decreases slightly in thickness and produces a uniform, slightly increased hardness of the nitrided surface.

Ernest H. Lyons, Jr.

The Role of Inhibitors in the Electrodeposition of Metals

HELLMUT FISCHER. *Z. Electrochem.* **49**, 342-46, 376-82 (1943); *C. A.* **38**, 3911 (1944).

In electrodeposition, the combined action of all the constituents of the electrolyte as well as the organic materials usually recognized as inhibitors may inhibit to some degree. Inhibitor action is usually related to selective adsorption on the electrode surface, but adsorption by the electrolyte at the electrolyte-electrode interface is also important. Inhibitors affect not only the polarization, but also the form of the voltage-cd curve. Listed in order of decreasing sensitivity to influence by addition agents, are electrodeposits of: (most readily affected) Ni, Co, Fe, Cu, Ag, Zn, Cd, Bi, Sn, Pb, Tl, (least affected).

Ernest H. Lyons, Jr.

Copper Plating on Aluminum

MARCEL GALLAY, *Metaux & Corrosion-Usure* **17**, 133-8 (1942); *C. A.* **38**, 2881 (1944).

For copper plating on pure or 13% Si aluminum, first dip it in a solution made up of 100 *l* water, 6 *l* $Fe(ClO_4)_2$ of 45° Bè, and 3 *l* HCl (sp.gr. 1.19). Give it a flash of nickel, then copper.

Ernest H. Lyons, Jr.

Effect of Lead on Alkaline Zinc Baths

W. ECKARDT. *Korrosion u. Metallschutz* **18**, 243 (1942); *C. A.* **38**, 2912 (1944).

1 g of lead was added (as lead acetate) to an 8 *l* bath containing 260 g ZnO and 1100 NaOH. After 10 min. plating, the deposit became spongy. If 3 g H_3BO_3 or 2 g vanillin was added, no spongy deposits occurred even after extended electrolysis.

Ernest H. Lyons, Jr.

The Porosity of Electrodeposits

H. FISCHER and H. BAERMANN. *Korrosion u. Metallschutz* **19**, 97-101 (1943); *C. A.* **38**, 2273 (1944).

Zinc coatings from sulfate baths were studied. There is a certain thickness above which pores are not detected. This critical thickness decreases as the cd or pH of the bath is increased. Aluminum sulfate, ammonium chloride or an aromatic sulfonic acid added to the bath, reduce the critical thickness. Aluminum sulfate also has a buffer effect on the cathode film. As in nickel plating, chloride ions increase the porosity of the plate and therefore increase the critical thickness considerably for higher pH values. The sulfonic acid reduces the critical thickness at low and medium current densities, but increases it again at high cd, either when added alone or along with the other additions. Combinations of the three additions were more effective than a single addition in reducing the critical thickness.

Ernest H. Lyons, Jr.

The Precipitation of Silver from K Ag $(CN)_2$

A. WOGRINZ. *Z. Metall u. Schmuckwaren-Fabrik. Sowie Verchrom.* **22**, 316 (1941); *C. A.* **38**, 1714 (1944).

Silver may be recovered from plating baths by precipitation on aluminum bronze. For 1 g of $KAg(CN)_2$, 0.9 g NaOH and 0.09 g aluminum bronze are required.

Ernest H. Lyons, Jr.

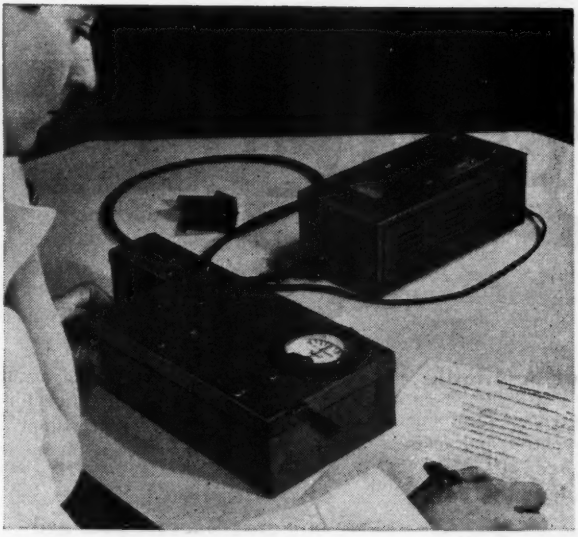
Recovery of Ag from Idle Ag Baths

A. WOGRINZ. *Deut. Goldschmiede-Ztg.* **45**, 111 (1942).

In the precipitation of Ag from a cyanide bath, Al bronze is preferred to Na_2S. In larger plants, it is recommended to evaporate the baths to the point where the major portion of the KAg cyanide is recovered by crystallization; these salts are used for new baths. The mother liquor is freed of Ag by NaOH and Al bronze. In small plants, only precipitation is carried out.

L. Pessel

(*Continued on page* 661)



The way to a better burnishing compound

• *By means of the reflectometer, a research man at Wyandotte Chemicals Corporation determines the relative reflectivities of brass plates burnished with various compounds and finds how improvements can be made. The result of such study was Wyandotte Burnishing Compound 315.*

IN Wyandotte Burnishing Compound 315 you have a *new* development! It contains no cyanide to cause you annoyance and hazard. Yet it removes tarnish from copper-base alloys, brass, bronze and copper more thoroughly than the old-type cyanide treatment.

Wyandotte Burnishing Compound 315 rinses freely from the work and burnishing balls — leaving no objectionable soap films to dull the work or hard water scum to necessitate frequent cleaning of equipment. Finished articles have a bright and lustrous surface.

Let your Wyandotte Representative show you how Wyandotte Burnishing Compound 315 can give you satisfaction. He's always at your service.

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INDUSTRY NEWS

Plating Supervisor Available

Ten years practical experience in production plating, chemistry, control and maintenance of solutions. Age 30. MR-6A, Monthly Review P. O. Box 168, Jenkintown, Pa.

Hard Chrome Consultant

Capable of setting up Hard Chrome shops, from plant layout to training personnel. Can also modernize your present setup, with latest and most efficient methods. Clarence H. Peger, P.O. Box 6322, Cleveland, Ohio.

Rate of Plating Operations in New York

The March *Monthly Bulletin* of the Masters' Electroplating Association, New York City, reports:

"The rate of operations among the Members of the Association for February was 72½%, and 76% for the first half of March, compared with 72½% in February 1945, and 72% in March 1945, based upon the present methods of calculation.

After a short recession in January, business picked up again in February and is maintaining itself at a good level. The industry is still very short of experienced polishers. If more were available, more help could be employed in the plating departments.

There are other shortages, also, which plague the industry at this time. Buffs are almost impossible to obtain and a number of shops are in a critical situation for that reason. Silver is still in short supply, and tin and cadmium have been placed under severe restrictions."

Teres Receives Award

Mr. Julius Teres of the Materials Laboratory, Wright Field, recently received the Army Commendation Ribbon "for exceptional meritorious conduct in performance of outstanding service in contributing to the alleviation of critical shortages in aircraft engine bearings by the development of a lead-indium plating process for bronze, lead-copper and silver bearings, by the adoption of the process to operate conditions existing at overhaul depots, and by assisting the depots in establishing proper plating procedures and control methods." The letter accompanying the award was signed by Major General B. W. Chidlaw.

Mr. Teres was graduated with the degree of Chemical Engineer from the University of Cincinnati in 1933. Following employment with Phillip Carey Company, Lockland, Ohio, he joined the staff of the Materials Laboratory at Wright Field in January 1936. He was commissioned in March 1942 and reached the rank of Captain. He returned to civilian status in December 1945.

Mr. Teres is well known in the plating industry by his work at Wright Field and his contributions at various meetings of the A.E.S. He is now in charge of the educational activities of the Dayton Branch.

Our heartiest congratulations.

Pennsalt Traffic Manager Retires

H. L. Crowder, Traffic Manager of the Pennsylvania Salt Manufacturing Company since January 1, 1918, announced his retirement recently after almost 30 years' service with the chemical company.

J. G. Robison, Assistant to Mr. Crowder for many years has been appointed Pennsalt's new Traffic Manager. William J. Robb has been named Assistant Traffic Manager.

Mr. Crowder, who is a member of the Traffic Club of Philadelphia and the Traffic Club of New York, has lived all of his life in Philadelphia, where he was born on October 5, 1885.

Mr. Robison is a native of Coatesville, Pa. He joined Pennsalt nine years ago after working for the Sinclair Refining Company in Fort Worth, Tex.

New Catalog On Cleaning and Drawing Compounds

A 24-page catalog of information regarding 39 different cleaning and drawing compounds has just been released by Northwest Chemical Co., 9310 Roselawn, Detroit 4, Mich. Five general classifications of cleaners are covered namely: (1) Electrolytic, (2) Immersion, (3) Solvent (4) Spray and (5) Water Wash compound for spray booths. The five types of drawing compounds that are described are particularly designed for (1) Superdraw "B" for brass and brass alloys, (2) Superdraw "V-113" for cold rolled steel, enameling iron, stainless steel and aluminum, (3) Superdraw "V-125" for steel alloys and stainless steels . . . also aluminum and brass, (4) Superdraw "M-99" designed for particularly heavy draws where only graphite or sulphur have been successful in the past . . . emphasized is the "Lo-Hi" pH process of cleaning metal preparatory to enameling or plating. It consists of both a low pH solution and a high pH solution, in separate tanks (two baths) to provide for the thorough removal of soil regardless of the degree of alkalinity or acidity.

Piske Leaves Zapon

Charles G. Piske has resigned as District Sales Manager of Protective Coatings Division of Atlas Powder Company at Stamford, Connecticut, after completing 26 years of service with that Company.

FOR SALE **Available for Immediate Shipment**

1—6500/3250 AMPERE, 6/12 VOLT, **CONNECTICUT DYNAMO AND MOTOR COMPANY** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—5000/2500 AMPERE, 6/12 VOLT, **CONNECTICUT DYNAMO AND MOTOR COMPANY** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—2500/1250 AMPERE, 12/24 VOLT, **CHARLES J. BOGUE ELECTRIC CO.** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—2000/1000 AMPERE, 6/12 VOLT, **CONNECTICUT DYNAMO AND MOTOR COMPANY** Motor Generator Set. Separately Excited. Excellent Condition. Full Control Equipment.
1—1500/750 AMPERE, 6/12 VOLT, **CONNECTICUT DYNAMO AND MOTOR COMPANY** Motor Generator Set. Full Control Equipment. Excellent Condition.
1—1500/750 AMPERE, 6/12 VOLT, **CHARLES F. L'HOMMEDIEU & SONS CO.** "RELIANCE" Motor Generator Set. Separately Excited. Full Control Equipment. Excellent Condition.
1—1500/750 AMPERE, 6/12 VOLT, **CONNECTICUT DYNAMO AND MOTOR COMPANY** Motor Generator Set. INTERPOLE CONSTRUCTION. Separately Excited. Full Control Equipment. Excellent Condition.
1—1000/500 AMPERE, 6/12 VOLT, **BENNETT & O'CONNELL** Motor Generator Set. Complete Controlling Equipment. Excellent Condition.
2—1440/720 AMPERES, 6/12 VOLT, **UDYLITE-MALLORY RECTIFIERS**—Input Rating: 220/440 volts, 3 phase, 60 cycles. Excellent Condition.
1—750/375 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE CO.** Motor Generator Set. Excellent Condition. Full Controlling Equipment.
15—60 AMPERE, 14 VOLT, **ROBBINS-MEYER ELECTRIC CO.** Motor Generator Sets (Brand New). Full Controlling Equipment.

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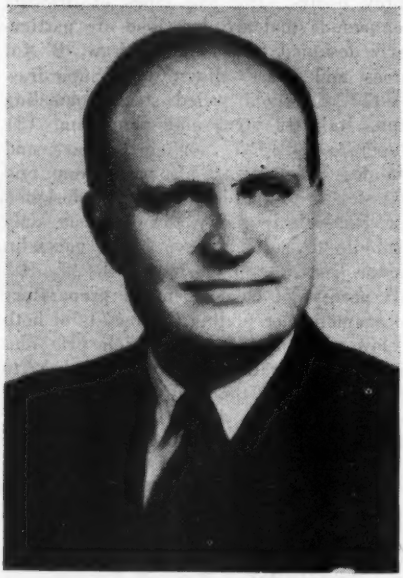
1—1000 AMPERE, 50 VOLT, **CHANDEYSSON ELECTRIC CO.** SYNCHRONOUS-DRIVEN Motor Generator Set, complete with Exciter and Full Controlling Equipment.
1—500 AMPERE, 60 VOLT, **WESTINGHOUSE** Motor Generator Set, complete with Full Controlling Equipment.
2—600 AMPERE, 40 VOLT, **MOTOR GENERATOR CORPORATION** Motor Generator Sets. Excellent Condition, Full Controlling Equipment.
1—500 AMPERE, 24 VOLT, **HANSON & VAN WINKLE CO.** (INTERPOLE TYPE) Motor Generator Set. Excellent Condition. Full Controlling Equipment.

M. E. BAKER COMPANY 143 SIDNEY STREET CAMBRIDGE, MASS.

Evans S. Schmeling Promoted by Wyandotte Chemicals



Evans S. Schmeling, well known to the metal cleaning and industrial finishing industry around Chicago, now headquarters at the Wyandotte office of Wyandotte Chemicals Corporation where he is assistant manager of their Industrial Department.

April of this year is Mr. Schmeling's seventh anniversary as a Wyandotte Industrial Department representative. After receiving both his bachelor's and master's degrees at the University of Michigan, he spent three years in Greenland on a geological expedition, and then joined the executive staff of a Cuban mining company.

Mr. Schmeling brings to the Wyandotte office a practical and comprehensive knowledge of metal cleaning and finishing procedures. He is at present engaged in the introduction of the new Wyandotte Buffing Compounds and Wyandotte Burnishing Powders. The Industrial Department of Wyandotte Chemicals is headed by Dr. Roy E. Heath.

New Officers of the Electrochemical Society

At the congress of the Electrochemical Society held at Birmingham, Alabama on April 11 to 13, the following new officers were elected:

ZINC PLATERS!

Use

McKeon's

Zinc-Brite

TRADE MARK REG'D.

to cleanse, and purify your zinc plating solutions.

Sample – full cooperation, free.

Sulphur Products Co.

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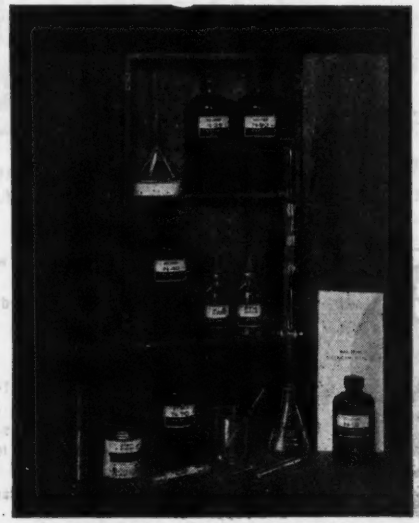
President — Wm. C. Moore, New York; Vice President — A. L. Ferguson, University of Michigan; Treasurer — W. W. Winship, New York; Secretary — Colin G. Fink, Columbia University, N. Y.

Dr. Moore is well known to members of his profession. He was born in Nashville, Tennessee, where he attended the University of Nashville. He carried out graduate research at the University of Chicago and received his Doctor of Philosophy degree in 1910. In 1920 Dr. Moore joined the research staff of the U. S. Industrial Alcohol Company and recently celebrated his silver anniversary with the company. Since January 1943 Dr. Moore has been a "dollar a year" consultant to the War Production Board and its successor agency, the Civilian Production Administration. At present he is still spending two days per week in Washington helping to liquidate the affairs of the former Office of Production Research and Development.

L. C. Kroes Advanced by Detrex Corporation

L. C. Kroes has been appointed manager of the Central Regional Sales according to an announcement made by A. O. Thalacker, vice president and general manager of Detrex Corporation, Detroit, Mich., manufacturers of solvent degreasing equipment and chemicals, metal parts washers, Triad cleaners and drycleaning equipment.

Mr. Kroes has been with Detrex Corporation since 1937 serving as a representative



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Simple test sets for aid in controlling plating and other solutions.

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Specify Kocour Sets from your supplier.

in the eastern region for three years when he returned to manage the Michigan Division in 1942.

Mr. Kroes is a graduate of the University of Michigan and is a member of the American Electroplaters' Society. His headquarters will be in Detroit.

Oakite TRI-SAN Booklet

Sanitation engineers, superintendents and foremen of metal working plants will be interested in a handy 20-page booklet published by Oakite Products, Inc., describing a unique chemical development for the control of obnoxious odors. This booklet gives data on successful application and uses of this recent scientific development known as Oakite TRI-SAN which is said to perform three important sanitation jobs of deodorizing, cleaning and disinfecting . . . all in one operation. Primarily designed to simplify plant sanitation procedures through its triple-duty properties, this material is reported to be especially effective in industrial plants where odor control is a recurring problem. Economy of use, ease of application and adaptability of Oakite TRI-SAN to special sanitation problems are other added features discussed in this booklet. Write to Oakite Products, Inc., 57 Thames Street, New York 6, N. Y. for your free copy.

Reisman Tool & Supply Co. to Represent E. Reed Burns in Philadelphia

E. Reed Burns Manufacturing Corporation, with offices at 40 Withers St., Brooklyn, New York, and plants in Brooklyn and Middlesex, N. J., announce the appointment of Reisman Tool & Supply Company, of Philadelphia, as their Eastern Pennsylvania representative.

Mr. Lawrence A. Reisman before the War, represented the Burns Company in the Pittsburgh district. He has a thorough and wide experience in the field of abrasives and in polishing and buffing methods.

The Reisman Company has offices at 44 North Fourth St., Philadelphia, telephone Walnut 0629. The company will service the area between York, Pa., and Trenton, N. J.

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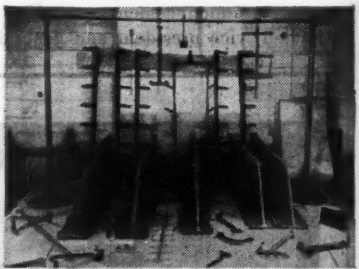


Here is a semi-hard thermoplastic coating that is being used successfully by many electroplaters.

Compare these points of superiority with your present coating:

1. **Damaged surfaces can be repaired by you with a repair paste we furnish.**
2. **Service Life of 6 months to a year.**
3. **Immediate service.**
4. **Application thickness of 1-16" to 1-8" to meet your requirements.**
5. **Positive insulation preventing loss of metal, more uniform coating and less current.**
6. **Approved by electroplating consultants and suppliers.**

Synthetic Rubbers Bakelite Plastics Vinyl Thiokol Neoprene Polyethylene

New Technical Bulletin Discusses Lead-Tin Alloy Plating

A new 12-page bulletin details information on plating of lead-tin alloys of low tin content. Two methods are described — one using alloy anodes, the other using dual anodes. The composition and operation of baths are described together with analytical methods for the control of both baths and deposits. Applications for lead-tin deposits are suggested. Copies of this thoroughly informative booklet, ZF-1, may be had on request to General Chemical Co., 40 Rector St., New York 6, N. Y.

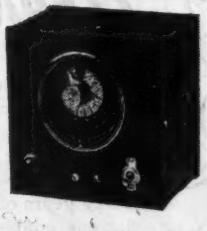
Pennsalt Net Earnings $1,288,066.07

The Pennsylvania Salt Manufacturing Company announced recently net profits of $1,288,066.07 for the year ending March 31, 1946, after deduction of Federal taxes. The profits, subject to final audit, represents $1.72 per share on 750,000 shares of $10 par stock outstanding, as compared with $1.90 per share for the 12 months ended March 31, 1945, when the net profits were $1,425,842.77.

Wooley Made West Coast Manager for United Chromium

United Chromium, Incorporated, announces the appointment of Richard J. Wooley as its West Coast district manager.

on the job for **TIMING PRECISION**



SIGNALLING TIMER

A new Timer designed to give the highest degree of precision control. The Series S Timer will command visual and audible attention the instant a time interval is completed. This Signalling Timer provides for the automatic closing or opening of a circuit at the end of elapsed time. As an indication of the versatility of the Signalling Timer, it will also operate additional buzzers, bells or lights at remote locations.

FEATURES OF SERIES S SIGNALLING TIMER

Rugged construction
Compact— 5 x 5 x 3½ inches
Dial calibration 1 second to 5 minutes
Maximum interval 1 minute to 3 hours
Motor, slow speed— self-starting
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Write for Bulletin A14

INDUSTRIAL TIMER CORPORATION

110 Edison Place **Newark, New Jersey**

He will be in charge of Unichrome sales and service for California, Oregon, Washington and British Columbia, and will make his headquarters at 4536 District Boulevard, Los Angeles 11, California.

Mr. Wooley is highly qualified by both technical background and extensive practical experience to render valuable assistance and service to the rapidly growing number of customers of Unichrome processes and materials in the Western area.

He has been connected with United Chromium, Incorporated, since January, 1944—first as chemist at its pilot plant and laboratories, and then as service engineer. Previously, he did important work as plating engineer at the Chrysler Evansville Ordnance Plant. Mr. Wooley was graduated from Michigan State College in physical chemistry and chemical engineering, and was senior instructor in physical chemistry.

Complete stocks of Unichrome materials for product finishing — including plating compounds, rack coatings, stop-offs, and organic coatings will be warehoused in Los Angeles. This strategic location will expedite deliveries of supplies, as well as provide the finest in service, to platers and product finishers throughout the area.

Zinc Plating Handbook for Sale

A 45-page booklet, 5½" x 8¼", entitled, *Current Zinc Electroplating Practice*, is offered for sale by the publishers of the magazine, *Steel*. The booklet consists of six articles originally published in *Steel*, Oct. 8 through Nov. 12, 1945, under the following separate titles:

"The Character and Life of Plated Coatings; Acid and Cyanide Baths; Operating Conditions".

"Continuous Electrogalvanizing Practice; Development and Evaluation of Solutions; Preparations of Base Metals".

"Fundamental Chemistry of Cyanide-Type Zinc Baths; Zinc Mercury Process; 'Bright' Plating".

"Control of Cyanide Plating Solution; Preparation of Base Metal Prior to Plating".

"Testing Quality of Electrodeposited Zinc Coating".

"Selecting Chromate, Anoding and Phosphate Types of Protective Coatings for Zinc Plated Surfaces".

These articles were prepared for *Steel* by Dr. Allen G. Gray of E. I. du Pont de Nemours & Co., Inc.

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. . . And rarin' to go . . . Your castings and metal parts are ready for finishing after a single run through a Blakeslee Metal Parts washer. Cuts cost, saves labor, production time and cleansing compound . . . Fifty years of experience and 5,000 installations enable us to solve your cleaning problems efficiently and economically. Take advantage of our engineering service.
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G. S. BLAKESLEE CO., CHICAGO 50, ILLINOIS
NEW YORK, N. Y. TORONTO, ONT.

The price is 50c for a single copy, with appropriate discounts on orders for ten or more. Orders should be addressed to Readers Service Dept., *Steel*, Penton Bldg., Cleveland 13, Ohio.

R. W. Pflug New Detrex National Accounts Manager

W. F. Newbery, industrial sales manager of Detrex Corporation, Detroit 27, Mich., manufacturers of industrial cleaning equipment and chemical cleaning compounds, has just announced the promotion of R. W. Pflug to national accounts manager.

Mr. Pflug, formerly central regional manager, started in the engineering department of Detrex Corporation in April of 1935. From the engineering department he was transferred to sales as service engineer on national accounts, and then was central regional manager until his recent appointment.

Mr. Pflug's latest appointment will enable him to bring to his new post a wide knowledge and considerable experience in the handling of sales accounts on a nation wide basis.

New Maintenance Hints For Business Executives

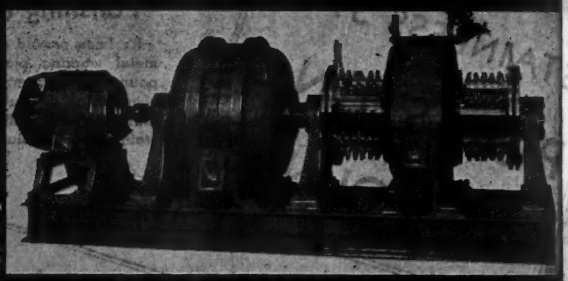
Of interest to Latin American business executives and maintenance officials are three new booklets, each available in both Spanish and English, offered by Turco Products, Inc. Fully illustrated, these booklets cover the fields of automotive maintenance and overhaul, aircraft maintenance and overhaul and general industrial processing and maintenance operations with complete information concerning new methods, products and equipment to help solve problems in less time at much lower cost.

Turco Bulletin AS-362 "How to Speed and Simplify Cleaning Methods in Industrial Plants" gives valuable information concerning rust removal, water-scale elimination, steam cleaning, paint stripping, metal surface treatment and general maintenance.

Bulletin AS-363 "How to Reduce the Cost of Automotive Maintenance Through Turco Chemical Methods" deals with all phases of motor and chassis cleaning, steam cleaning, hot and cold tank immersion, radiator protection and car washing.

Bulletin AS-364 "How to Reduce the

COLUMBIA MOTOR GENERATORS



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Columbia Generators embody every feature essential for dependable, 24-hour operation. They are built for electroplating service in sizes of 6 to 20 volts, 500 to 20,000 amperes, for anodic treatment of aluminum in sizes of 40, 50, and 60 volts, 500 to 3,000 amperes. Columbia Generators for other electrolytic processes range from ½ to 250 KW, 100 to 40,000 amperes, 6 to 60 volts. Write for full information.

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Chicago Office — 1525 E. 53rd St.

Cost of Aeronautical Maintenance Through Turco Chemical Methods" covers the entire field of aircraft cleaning with particular attention to paint stripping, parts cleaning, steam cleaning and special products for both interior and exterior finishes.

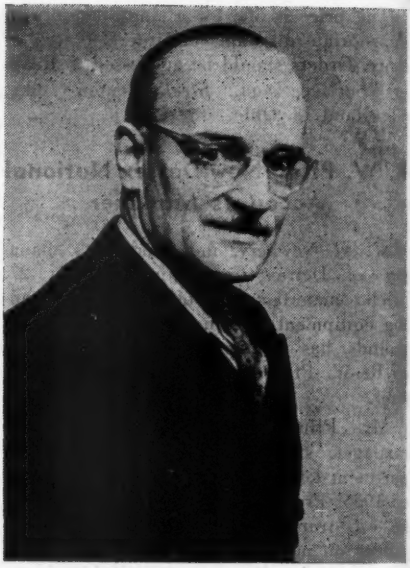
Address all inquiries to Turco Products, Inc., Export Sales Division, P.O. Box 2649 Terminal Annex, Los Angeles 54, California.

Optimus Equipment Appoints Fidelius

Walter R. Fidelius has been appointed Assistant Chief Engineer by the Optimus Equipment Company, Matawan, N. J., manufacturers of metal washing and drying equipment.

Mr. Fidelius was formerly with the Fitzgibbons Boiler Company, Inc., of Oswego, N. Y. There for thirteen years he was maintenance engineer and during World War II as Superintendent of Tank Hall Department.

Prior to that, Mr. Fidelius was associated with the Williamsburg Power Plant Corporation, Brooklyn, N. Y. as test engineer supervising tests in electric and steam power operation.



A graduate of Cooper Union with a B.Sc. in Mechanical Engineering, Mr. Fidelius continued further studies on this subject at New York University. In his new post, he will supervise in design, construction and service.

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If It's Stainless Steel Polishing It's a "4-A" Job

It's been proved every day in every kind of metal working plant: "4-A" Polishing Compounds are faster, more efficient and more economical for cutting down, polishing and mirror finishing all kinds of steel, including stainless and radium.

Use it with any kind of wheel —soft, medium or hard—and the results will speak more eloquently than anything we could say.

Tell us about your toughest job, and we'll be glad to send the "4-A" product that will solve your problem No obligation, of course

Instead of glue, use "4-A" Cement and Thinner, a uniform substitute for polishing Wheels, Belts, Buffs, Rolls, etc Samples of Compound or Cement sent on request

HARRISON & COMPANY HAVERHILL, MASS.

CEMENT AND THINNER

New Technical Bulletin Discusses Zinc Plating From the Fluoborate Bath

A new 12-page bulletin discusses the advantages of Zinc Fluoborate Solutions in high-speed continuous and tank plating operations. Operating details are given for various plating processes together with analytical methods for bath control. This well prepared booklet, LTF-1, should make a useful addition to any electroplater's library. Copies may be had on request from General Chemical Co., 40 Rector St., New York 6, N. Y.

Electrochemists Award Prizes To Young Authors

The Annual Prize of $100.00 awarded to Young Authors of original electrochemical manuscripts this year goes to Dr. Austin Eugene Hardy, for his paper on the "Photoconductivity of Zinc-Cadmium Sulfide". Dr. Hardy was born in Concord, N. H., in February 1921. During the war he worked on phosphors for use in Radar Cathode Ray Tubes. He is a natural born scientist.

The F. M. Turner Prize of technical books ($50.00) was awarded to Dr. James T. Waber for his manuscript on "Stress Corrosion Cracking of Steel". The investigation was carried out at the Illinois Institute of Technology, Chicago, Ill. Dr. Waber is but 26 years old, and a chemical engineer of great promise.

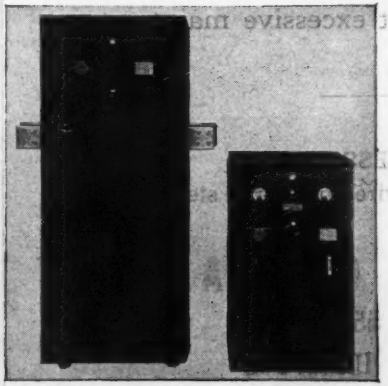
The two prizes were awarded at the Spring Congress of The Electrochemical Society which was held at Birmingham, April 11th; 1946.

A.S.T.M. Annual Meeting

The American Society for Testing Materials will hold its 49th Annual Meeting at Buffalo, N. Y. during June 24 to 28. Many of the Committees will meet including Committee B-8 and several of its Sub-Committees and Sub-Groups. Meeting headquarters is the Hotel Statler.

Requests for room reservations should be mailed to Mr. A. J. Morgan, Manager Convention Bureau, 602 Genesee Building, Buffalo 2, N. Y.

LARGE VARIABLE PLATERS NINE MODELS



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Supplied as Basic Rectifier with Separate Remote Control with Stepless Variable Transformer, Meters, Pilot Light. Also supplied as Self-Contained Rectifier with Meters and Stepless Variable Auto Transformer Control incorporated in same cabinet.

Specifications

6 Volts — 500 Amperes Variable Plater

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12/6 Volts — 500/1000 Amperes Combined Unit

Units may be used on either 220 Volts or 440 V, 3 Phase, 60 Cycles.

For special Selenium or Tube D. C. power requirements write for Rectification Questionnaire and literature.

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NEW Equipment Materials Supplies

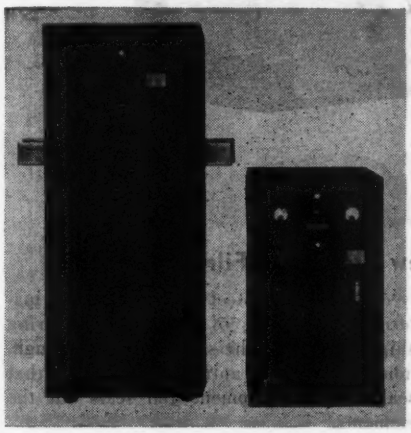
Richardson-Allen Offers Variable Platers

Richardson-Allen Corporation, 15 West 20th Street, New York 11, N. Y., offers a line of nine models of large variable platers.

The specifications are 6 volts — 500 amperes; 6 volts — 1000 amperes; and 12/6 volts — 500/1000 amperes. Models can be supplied as basic units with separate remote control (as shown), or models as self-contained units with meters and stepless variable auto-transformer.

All units are finished in a rich mahogany wrinkle. Basic units are 24 inches square by 60 inches high approximately. Remote control units are approximately 36¾ inches high, 21 inches wide and 15 inches deep.

Long life selenium rectifier employed.



Units designed for 220 V or 440 V, 3 phase, 60 cycles, and are available for 25 cycles at small additional cost.

Bus bar on both sides of cabinet for load connection. Efficient down-draft ventilation with oversize capabilities. Units may be combined in series or parallel arrangement or both to increase voltage or current. The stepless variable auto-transformer permits continuous control of output from no-load to full-load.

"YANKEE BRAND"

PROGRESSIVELY BETTER ABRASIVE COMPOUNDS

Tailored to fit all finishing requirements.

Inquiries respectfully solicited

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Manufacturers

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New Metal Washing Machine Announced by Optimus

Optimus Equipment Company, 131 Church St., Matawan, N. J., has just introduced a new continuous type washing machine for handling large numbers of metal parts on racks, before plating, painting or any similar process. It will handle any type of parts provided they are free-draining, and the sprays have free access to the parts. The output of this machine is high — 60 racks per hour being a common figure.

This new machine can be used as a single stage washer, or it can handle a number of successive operations, alkaline, acid, or neutral. With slight alterations, this machine can take care of a series of different operations — washing, rinsing, drying, pickling, cyanide treatment, etc. For acid solutions, the machine is of acid-proof construction. In most cases, it is desirable to use it only as a washing and rinsing machine. Its greatest use is for removal of buffing compositions before plating.

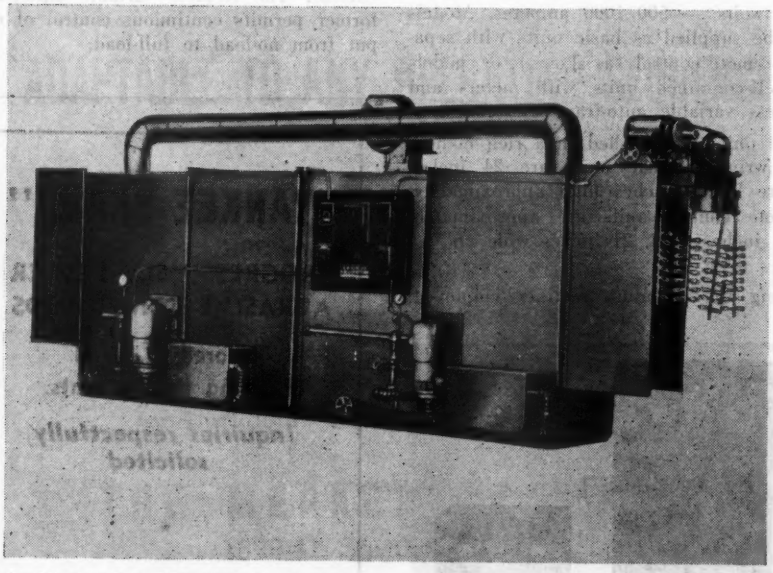
The machine works closed and may be connected to an exhaust blower so that fumes, unpleasant odors or excessive heat is not developed. It can be heated by steam, gas or electricity.

A number of manifolds with spraying nozzles are mounted on all sides of the washing chamber. Solution circulation system includes a pump, piping, filters and strainers and all necessary heating devices and accessories.

The conveyor is an overhead chain type winding around two end sprockets driven by motor and speed reducer with variable speed pulley.

Machine is supplied entirely ready to use and may include electric panel, all switches and exhaust blower. Side insulation may be provided for comfort of the operators.

Thermostatic control is available for any type of heating.



Zapon Announces New Protective Film

The Zapon Division of Atlas Powder Company announces the development of a new product, "Brevon," an air-tight, plastic covering that protects machines, equipment and other products which must endure long periods of exposure. Brevon, originally designed to protect Army and Navy materiel in all types of weather and during shipment, covers the surfaces with a tough, non-inflammable, anti-corrosion film that seals in the equipment and seals out the elements.

The new strippable covering is used on machine tools, equipment or anything else requiring protection during shipment, export or storage.

Brevon is applied by spraying. Objects with projecting parts are first covered with a latticework of tape strips over which Brevon webbing solution is applied, bridging gaps as wide as 16 inches in the webbing.

The covering has a life span of 20 years; it resists a tensile pull of 2,000 lbs. per square inch; it is flexible; provides low vapor transmission rate under high pressure; and retains all its qualities through a temperature range of 40 degrees below zero to 200 degrees Fahrenheit.

The company anticipates a wide market for this product in industry where packing protection is required as in export shipments and extended storage.

New Air-Dry Rack Coating

To solve one of the plating industry's greatest needs, a new air-dry rack coating developed specifically to overcome the difficulties commonly found in applying lacquers is announced by Michigan Chrome and Chemical Company, 6340 East Jefferson Avenue, Detroit 7, Mich. The following data is supplied by the manufacturer:

Known as Miccrotex, this new air-dry rack coating is a thermoplastic insulating material which meets the requirements of all plating, anodizing, tannerizing, parkerizing, and bonderizing cycles. Miccrotex has essentially the same ingredients and effective insulating properties as Miccrotape and Miccrotube, both products of the Michigan Chrome and Chemical Company, which are enjoying wide usage throughout the plating industry.

Microtex is tough, resilient and flexible and completely overcomes the difficulties commonly found in lacquers which have a tendency to become brittle with use, causing seepage under the coating and then peeling. It attains maximum adhesion without depending upon shrinkage. Miccrotex is a black material with a high luster, unaffected by any solution commonly used in plating and anodizing cycles, including the electrolytic sulphuric acid strip used to dissolve bright nickel, and alkaline clean-

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ers at boiling temperatures. The only exceptions are some of the organic solvents used in vapor degreasing. Miccrotex is also very effecfive in minimizing dragout.

Miccrotex may be successfully dipped, brushed or sprayed, depending upon the construction of the rack. It is easy and economical to use — saves time and material in application.

Miccrotex is the result of years of research in the laboratories of the Michigan Chrome and Chemical Company and thoroughly tested by their experienced platers. The full story of Miccrotex new air-dry rack coating is contained in a special bulletin available upon request. Write to Michigan Chrome and Chemical Company, 6340 East Jefferson Avenue, Detroit 7, Mich.

Work Holding Spinner for Polishing Round Parts

Far greater speed and much more uniform results in polishing round, cylindrical and flat circular pieces is made possible by Presto Work Holding Spinners, announced by The Manderscheid Company, 810 Fulton St., Chicago 7, Ill.

A removable fixture flange with machined surface provides for easy mounting of wood blocks or other fixtures to hold parts of various shapes and sizes. Extra flanges at nominal cost permit keeping any number of fixtures mounted on flanges ready for instant use.

For fixtures to hold smaller parts a flat headed screw is provided in the spinner shaft.

Structural features are as follows:

1. One-piece shaft and brake assembly closes the housing against dust and grit.
2. Grease packed and sealed ball bearings, mounted in precision machined seats.
3. Dustproof rubber closure.
4. Removable fixture flange has machined face and screw holes.
5. Threaded shaft for fixture flange.
6. Spanner wrench hole for easy removal of fixture flange.
7. Screw for holding small fixtures.
8. One-half inch shaft.
9. One and one-quarter inch diameter housing affords man-size grip.

Made in two sizes: No. 221 is 10½" over all and No. 221-A is 7½" over all.

Finishing Foremen:

We can prove BURNS STEEL SHINE meets every requirement in cutting and coloring Stainless or Carbon Steels — from sharp cuts without color to producing mirror finishes. Detail problems to us for samples of the right grades.

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New Oakite Product

Announcement of a new product for the prevention of rust on ferrous surfaces between operations and while parts are in storage is made by Oakite Products, Inc.

Known as Oakite Special Protective Oil, it has already found wide use in many plants where temporary or semi-permanent surface protection from rust is desired for parts or work, following such operations as grinding, machining, pickling, tumbling, sand blasting, brazing, etc.

Oakite Special Protective Oil imparts a thin, transparent, rust-preventive coating which does not interfere with accurate gauging or stain or discolor ferrous surfaces.

Parts to be rust-proofed either may be immersed dry, or, because of the water displacing properties of Oakite Special Protective Oil, may be immersed immediately after cleaning and rinsing, while parts are wet, thereby eliminating the necessity for drying surfaces by a special hot rinse, air, sawdust or other methods generally used for drying prior to applying rust-preventive.

In addition, finger prints or similar marks resulting from inspection or handling of machined work in process can be readily removed by adding 5 per cent water to the Oakite Special Protective Oil.

A new, free, 16-page booklet describing the many industrial applications of this product is available upon request to Oakite Products, Inc., 40 Thames St., New York 6, N. Y.

Naugatuck Chemical Co. Announces Three New Interesting Products

Non-chipping, non-yellowing plastic enamel for refrigerators and kitchen appliances; a textile treatment to give fabrics a permanent "starch"; and a moisture-proof coating for packaging, shipping machine parts and for stop-off work were announced recently by the Naugatuck Chemical Division of United States Rubber Company.

The new enamel is said to be well suited for such severe service applications as hair dryers, which operate at high temperatures; kitchen equipment where a

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Consulting and Research Engineers
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high gloss, non-yellowing white is required and hospital equipment which must be chip proof and chemically resistant.

Completely invisible on the fabric and unaffected by laundering and dry cleaning, the new textile treatment is said to give nurses' uniforms, women's summer dresses, sheets and shirts a permanent "starchiness" under all weather conditions. Bed spreads are said to retain their neat appearance longer when made from fabrics treated by this new process. Draperies have improved fold and hang. Curtains appear fresher and dresses retain their newness. The treatment, called Kandarizing, is non-toxic, non-irritating and will not tenderize the finest white broadcloth or most colorful chintz.

The new plastic coating, tough, moisture-proof and resistant to salt water, was developed originally for the Army Air Forces to protect planes on the decks of freighters and tankers during shipment overseas. It finds peacetime application in the shipment of machine parts, for sealing bottles and as a stop-off lacquer for the electroplating industry.

All three new products are the result of research in new synthetic resins by the general laboratories of the rubber company and are produced by the Naugatuck Chemical Division at Naugatuck, Conn.

The new synthetic resin enamel is resistant to high temperature and is applied by conventional methods and baked to an extremely durable finish. It is flexible, has high impact strength, superior hardness, high gloss and a minimum discoloration upon exposure to light or heat.

Also making use of a new synthetic resin, the textile treatment adds only 1½ to 2 per cent to the original weight of the fabric. Applied at the time of manufacture in the form of a water emulsion, the treatment lends itself readily to present textile processing equipment. It requires no cure and is unaffected by bleaching agents. Fabrics are immersed in the emulsion, squeezed and dried at a temperature ranging from 212° to 250°F.

Advantages of the new plastic coating, called Kotol, are low moisture-vapor transmission, good elongation and toughness as illustrated by its tensile strength of 900 pounds per square inch. The coating has

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trouble?
in your BUFFING and POLISHING?

Divine Brothers, Utica, N.Y., have been investigating problems, offering advice, recommending practical solutions, proper treatments and equipment for all kinds of finishing since 1892.

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PERMAG Compounds produce excellent results when used in both burnishing and tubbing processes. Brass, aluminum and steel parts are brought to a lustrous finish in the burnishing barrel with proper amount of PERMAG Compounds. Glad to send you details. Write us.

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a wide temperature range with flexibility at —40°F and good aging characteristics at 180°F. The coating is applied by spraying or dipping and is then dried, either by air or baking at 250°F.

Since the material has high resistance to acid and alkaline plating solutions at high temperature, it will be valuable as a rack coating and stop-off lacquer in the electroplating industry. In this use, the strippable coating saves valuable metal by preventing it from being deposited on coating racks and by masking parts of objects where electroplating is not desired.

Continuous Viscosimeter

A new kind of continuous Viscosimeter is described by the Fischer & Porter Company in a technical bulletin recently released. The operational characteristics represent a radical departure from the conventional method of viscosity measurement. The instrument is so constructed as to permit the instantaneous observation of viscosity values existing in a moving fluid stream under full line pressure. This Viscosimeter is available in simple indicating form, or arranged for continuously recording viscosity values on a 24-hour chart or for controlling fluid viscosity by automatic blending or heating means. The instrument is said to be particularly valuable for continuously blending lube oils, indicating the end points in various plastic processes and in the maintenance of constant fuel oil viscosity for improved oil burner operation.

You may obtain a copy of this bulletin by writing to Fischer & Porter Company, Department 8W-12, Hatboro, Pa.

Dr. Mitchell J. Fain Rejoins Foster D. Snell, Inc.

Dr. J. Mitchel Fain, lately Colonel with the Army Air Forces, has rejoined the staff of Foster D. Snell, Inc., Consulting Chemists and Engineers, 305 Washington St., Brooklyn 1, N. Y., has account executive in charge of technical development for a group of manufacturers of chemical specialties. For the past four years Col. Fain has been on a military leave of absence.

As Chemical Officer of the North Air Force he served in India, Egypt, Libya, Tripoli and Tunisia. Battle stars were awarded him for participation in the Egypt-Libya and Tripoli-Tunisia campaigns. Lt. General Brereton commended Col. Fain for his efforts in planning and preparation of operations in support of the invasion of Sicily and the attack on the Ploesti Oil Refineries. When he returned to the United States he became Chemical Officer of the Western Flying Training Command for which service he was highly commended.

ABSTRACTS

(*Continued from page 642*)

Electrodeposition of Metals. Silver

A. T. VAHRAMIAN. *Acta Physicochem.* **19**, 148-62 (1944) in English; *C. A.* **39**, 1597 (1945).

Polarization depends on the true current density, rather than the apparent current density. Silver becomes passive in a silver nitrate solution by adsorbing organic impurities. It does not become passive in a cyanide plating bath because cyanide is adsorbed in preference to the organic impurities. New technics and studies of polarization indicate that on the "growing" portions of the cathode, it is essentially due to concentration changes.

Ernest H. Lyons, Jr.

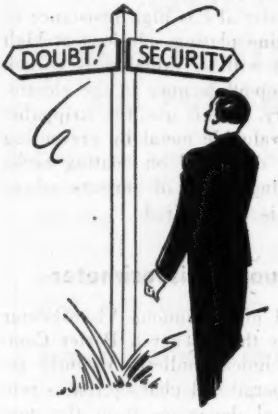
The Chemistry and Structure of Anodically Produced Deposits and Surface Films. III. The Color of Anodically Produced Films of Zinc Oxide

K. HUBER, *Helv. Chim. Acta*, **27**, 1443-55 (1944) (in German); *C. A.* **39**, 1598 (1945).

Oxide films may be applied to zinc by anodizing in alkaline solutions. The color of the film depends largely on the pH and the buffering of the electrolyte. In phosphate, carbonate and borate solutions, the films were light in color and high in resistance when the pH was from 9 to 12.5. At sufficiently low pH, the light-colored film was pierced by white, loose deposits, beneath which the zinc was active. When the pH was 12.5 to 13.0, the films were dark brown and low in resistance; it was shown that these films contained some metallic zinc as well as zinc oxide; three different types of films were observed.

Ernest H. Lyons, Jr.

In the Long Run It Costs Less to Play Safe



AS a general rule it pays to put the best possible performance into tank equipment at the beginning. When the costs represented by shut-downs and spoilage, repair and replacement, are added to the purchase price of tanks of doubtful design, the final cost is not so attractive. Storts-welded tanks have been the preference of careful buyers for many years, because they are designed and manufactured to give a maximum of dependable and trouble-free service. If you are interested in top tank values, send your current or future requirements to Storts for quotation.

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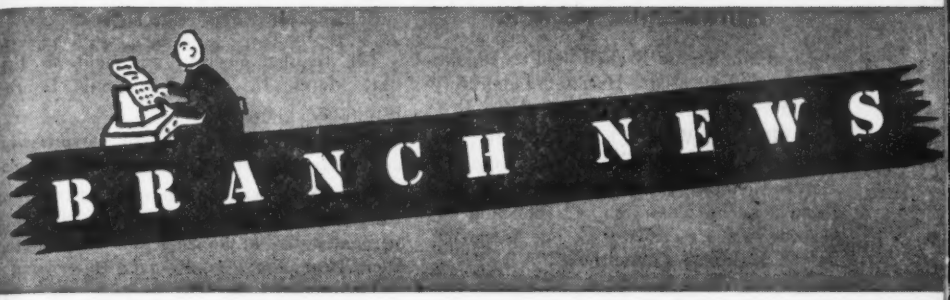


MONTREAL BRANCH

The regular monthly meeting was held on May 13 in the Mount Royal Hotel. President Reg Gordon opened the meeting with only 12 members present, a very poor showing.

One of the important events of the evening was the installation of Officers by our old friend and founder of the Montreal Branch, J. H. Feeley. A hearty vote of thanks was extended to the retiring President R. E. Gordon for his excellent work during the past year.

The new Officers are:
President—G. R. Davidson
First Vice President—C. Briseboil
Second Vice President—F. Boston
Third Vice President—E. Boulet
Secretary-Treasurer—W. Glover
Librarian—J. T. Reisenberg
Board of Managers: C. Douglas, D. McMullin and O. Moldenschart.

The Membership Committee reported two applications for membership. The Exhibits Chairman reported having taken care of the Montreal exhibit. Delegates to the Convention were empowered to vote on the proposed amendments. Strenuous efforts are beng made to enable the Branch Secretary to attend the Convention as it is felt that the meeting of Branch Secretaries with the Executive Secretary will prove well worthwhile.

The Educational Session was taken up with the following questions:

Q. 1—Why is a granular deposit formed in a silver solution when the work is placed lower in the tank?

Q. 2—Are cathodes seriously attacked when hung in a cyanide solution without current?

Q. 3—What are the results of using an anode area much greater than the cathode area in a silver solution?

Q. 4—What are the indications of a silver solution being deficient in (a) metal, (b) cyanide, and (c) carbonates?

WM. GLOVER, *Secretary-Treasurer*

GRAND RAPIDS BRANCH

The Grand Rapids Branch held its final meeting of the season on May 12 in the English Room of the Rowe Hotel.

A short business meeting was held after a delicious dinner had been enjoyed by the members and guests. The chief business was the installation of Officers for the coming year, adequately handled by Maurice Caldwell, and the election of Delegates for the June Convention. Messrs. Caldwell, Hepfer and Preston were chosen Delegates, with our President, Jim Badaluco, as Alternate.

In lieu of a speaker, our Librarian had arranged for a board of "experts" which was to answer any and all questions fired at them by the members. This worked out extremely well in that we were fortunate in having some very pertinent questions. These were well taken care of in every case by Bob Dudley of United Chromium, Inc., R. B. Saltonstall of The Udylite Corporation, Harry Benner of E. I. duPont de Nemours & Co., Ivan Hepfer and Jake Markham of Winters and Crampton Corporation. Our Assistant Librarian, Bob Meech, did a good job as moderator, and the entire program was a success, judging by the comments of the members. The evening was topped off by "night caps" through the courtesy of our member and good friend, "Dusty" Rhodes of the Northwest Chemical Company.

RANSOM B. PERKINS, *Secretary*

PHILADELPHIA BRANCH

The Philadelphia Branch held its regular March meeting at the Harrison Laboratory with President Zurbach in the chair.

Dr. Richard Wick, Chairman of the Research Directing Sub-Committee of the Research Committee and a member of this Branch, spoke about the projects now under way and described how one is started by the Research Committee.

Dr. A. K. Graham, A.E.S. Executive Secretary and also a member of the Philadelphia Branch, cited the difficulties encountered in the Executive Office in these times of strikes and material shortages, a situation similar to that existing in a manufacturing plant.

Librarian Hirsch then introduced the speaker of the evening, Dr. Frederick C. Strong, of the Department of Chemistry, Cedar Crest College, Allentown, Pa., whose subject was "Atmospheric Corrosion of Iron and Steel". Of particular interest was his discussion of microscopic examination of corrosion products.

The speaker's discourse brought to the platers the needs for more study of this subject and for better preventive measures.

Four candidates were elected to membership. There was one reinstatement, one out-transfer and three applications.

PAUL MENTZER, SR., *Secretary*

MONTREAL BRANCH

The regular monthly meeting was held at Mt. Royal Hotel on April 8.

Since the attendance was only 22 per cent of the membership and had averaged, during the past year, only 23 per cent, it was agreed among those present that they should contact other members on meeting nights.

One resignation was accepted.

Nominations were voted upon for a complete slate of new officers.

Mr. G. R. Davidson gave a running commentary on two films on automatic polishing and buffing. He then presented a paper prepared by Mr. V. L. Richards of Canadian Hanson-Van Winkle Company on "Relative Merits of Plating Rectifiers and Generators", a subject of extreme interest to the members.

WILLIAM GLOVER, *Sec'y-Treas.*

NEWARK BRANCH

The regular meeting was held on Friday, March 15, President Louis Donroe presiding.

There were five elected to membership, one in-transfer and three applications.

Mr. Smith was appointed Chairman of this year's Picnic Committee with the perogative of appointing the rest of the Committee.

The speaker for the evening was Mr. Zachary Irenas, a member of Newark Branch. His discourse on "The Significance of Water in the Plating Room" was probably the best ever presented at any of our meetings on purification of water. Mr. Irenas was kept on his feet answering questions for half an hour, after which he was given a rising vote of thanks with much applause by the 61 members who attended.

GEORGE WAGNER, *Secretary*

CHICAGO BRANCH

The regular monthly meeting was held in the Hamilton Hotel on April 12, with 80 in attendance.

Members who have back numbers of THE REVIEW were asked to send them to the National Office for distribution among the libraries of the country.

The new officers for the year are: President, Clyde Kelly; 1st Vice President, O. T. Towner; 2nd Vice President, L. Kocour; Librarian, C. W. Carter; Secretary-Treasurer, M. H. Longfield; Board of Managers, R. J. Hazucha, J. W. Hanlon and C. Iwen.

Mr. Hensley of the Atlas Powder Co. spoke on "Industrial Finishes". A movie and exhibit of finishes made the evening very interesting.

M. H. LONGFIELD, *Secretary*

TOLEDO BRANCH

In the absence of President Miner, Mr. Vannorsdall took the chair at the regular meeting on March 7. Thirty-six members and four guests, two of whom were Chinese students, attended.

After a lengthy discussion it was decided to ask the Executive Secretary of the Society to poll other Branches to de-

termine if their members were encountering the same difficulties in obtaining buffs as the Toledo Branch members, and to organize a concerted effort to relieve this situation. It was believed that if the proper authorities in Washington were advised of the situation, they would take steps to alleviate it.

Mr. Sampson of the General Electric Company, Chicago, then gave an interesting talk on "Dry Plate Rectifiers".

GASTON BERGEMAN, *Secretary*

BRIDGEPORT BRANCH

Sixty-two members and guests were present at the Open Meeting and Educational Session on Friday, March 15.

Technical Chairman A. R. McNeil introduced Mr. Oathout of the Behr-Manning Corporation, Troy, N. Y., who spoke on "Polishing by the Abrasive Belt Method" and showed a film which pictured the manufacture, packing and shipping of the abrasive belts. Mr. J. L. Swennson gave an actual demonstration of polishing on a portable unit and showed how many parts could be finished efficiently with it.

JOSEPH G. STERLING, *Sec'y-Treas.*

CLEVELAND BRANCH

The regular monthly meeting on Friday, April 5, at the Cleveland Hotel was a Joint Meeting with the Local Section of the Electrochemical Society.

President Steve Miller turned the meeting over to Librarian Ralph Schaefer, who introduced the speaker of the evening, Mr. R. O. Hull. Mr. Hull is a member of both the Cleveland Branch and the Electrochemical Society and well known to all of us. He gave a very interesting talk on "Advancing the Art of Electroplating", with emphasis on new plating developments. Slides were used in a discussion of continuous tin plating of strip steel. A question period followed.

At the business meeting five new members were elected and two applications read. A Nominating Committee was appointed.

HARVEY P. HEIL, *Secretary*

LOS ANGELES BRANCH

Hailing Los Angeles Branch's 16th Anniversary, members, supply company representatives, and their friends attended the 1946 Educational Session and Banquet at the Los Angeles Breakfast Club on Saturday, March 23.

The plating industry on the Pacific Coast and its friends gathered to pay tribute to W. L. Pinner, A.E.S. President, who enjoys the outstanding distinction of being the only recipient of four Gold Medal Awards from the Society. With the suspension of hostilities and the improvement in transportation facilities, it was possible to have with us a number of prominent Easterners, all of whom contributed to make this year's Educational Session one of the finest.

The program was conducted by Branch Librarian John F. Beall, assisted by Emmette Holman, former Librarian and President of the Branch.

The Educational Session, which began at 10:30, was very well attended, the large numbers present and intense interest displayed indicated clearly the important position of the electroplating industry in Southern California.

Mr. R. O. Hull of the R. O. Hull Company, Cleveland, Ohio, had for his subject "New Methods in Electroplating". Among the interesting developments discussed by Mr. Hull was electrotinning of steel sheets. His remarks were accompanied by slides showing the entire process. Mr. Hull described in some detail the use of the Hull Cell in controlling the constituents of all types of plating solutions.

A most interesting report was given by Mr. Walter Pinner of the progress made by the Society during his presidency. It was most gratifying to note that copies of the REVIEW are being made available to principal libraries throughout the country. The Research Program was described in some detail. As a result of these activities the Society now enjoys national recognition as a professional society rather than a trade organization.

With the return of peace-time activities, Southern California has made a good start at taking its rightful position as the entertainment center of the world. Keeping pace with this trend is a great increase in pro-

duction facilities for making phonograph records. A most interesting and informative discussion of the background and production methods in the manufacture of records was presented by Mr. Charles Eckart of Charles Eckart Company, one of the concerns engaged in that industry. Mr. Eckart had brought a turntable and demonstrated the improvements that have been made.

Returning to California for the first time since studying at California Institute of Technology was Mr. Ernest Lyons of The Meaker Company, Chicago, Ill. Mr. Lyons presented comparative corrosion test data from salt spray and weather exposures of various metals and alloys. His remarks added to the rapidly accumulating evidence of the general unreliability of salt spray tests for the prediction of performance under actual weathering conditions.

After rocking the boys with laughter by his luncheon story, Mr. Wm. Jackson of The Udylite Corporation, Detroit, Mich., came back in the afternoon with a serious and informative discourse on "Modern Barrel Plating Equipment". Slides were shown of typical barrel plating layout and sequence of operations.

The final speaker of the day was A.E.S. President of W. L. Pinner of the Houdaille-Hershey Corporation, Detroit, Mich., who spoke about high speed nickel plating. (See MONTHLY REVIEW 32, 227-34 (1945).)

The members and guests were then given an opportunity to ask questions of the panel of experts and a most interesting session ensued.

At 7:45 o'clock the doors were thrown open to the banquet hall where tables were quickly filled and guests were eager for the sumptuous turkey dinner, at the same time being serenaded by the three "Spanish Cabelleros".

Following the dinner, E. W. Wells, President of the Los Angeles Branch, after a few introductory remarks, introduced the General Chairman who officially opened the Banquet Program. At the conclusion of his statement, Mr. Rynkofs introduced Mr. W. L. Pinner, the first A.E.S. President to appear at one of the Pacific Coast's annual affairs.

In his remarks, Mr. Pinner said that Los Angeles could handle an A.E.S. Convention as well as any Eastern city. He would be one of the first to come to Los Angeles again. That Mr. Pinner's remarks were well received was evidenced by the thunderous applause.

Vice President D. N. Eldred was introduced as conductor of the Door Prize drawing. He was assisted by President E. W. Wells, Second Vice President Howard Woodward and former Secretary-Treasurer C. C. McLaren. Mrs. Eleanor Oliphant was selected to draw the lucky numbers for the fifty costly door prizes, a variety of post-war plated, useful home articles.

With Art Whiting and his eight assistants furnishing the dance music and entertainment, Los Angeles Branch closed another page in its history.

M. D. RYNKOFS.

NEWARK BRANCH

The regular meeting was held on April 19 at the Hotel Robert Treat. In the President's absence, the meeting was called to order by First Vice President John De Vries.

There were two applications and one in-transfer.

The guest speaker for the evening was R. O. Hull, whose subject was "Simplified Electroplating Control Methods". His talk was accompanied by slides and proved very interesting. He was given a rising vote of thanks by the 48 members who attended.

GEORGE WAGNER, *Sec'y.*

SYDNEY BRANCH

The regular meeting of the Sydney (Australia) Branch was held on 14th May, at the Chamber of Manufactures. The meeting opened at 8:00 P. M. with President Phelan presiding.

There were three elections to membership and one application.

Librarian Heard introduced Les. Edwards, Ern Wright and Fred Baker as a "Brains Trust" to answer questions pertaining to barrel plating. This was done very ably and the members received some valuable information on the technique of barrel plating.

LAWRENCE SMITH, *Secretary*

PHILADELPHIA BRANCH

Philadelphia Branch held its regular April meeting at Harrison Laboratory of the U. of P., with President Zurbach in the chair.

Four new members were elected. There were one application, one out-transfer and two suspensions for non-payment of dues.

John Fusselman, who has been in the Service for the last two years, has returned to active membership.

Following the reading of a communication from Maurice Caldwell, the Branch decided to assess each member two dollars for this year for the benefit of the Research Fund.

The following officers were elected for the next fiscal year:

President—Henry Orlik
First Vice President—T. M. Rodgers
Second Vice President—Samuel Heiman
Treasurer—G. M. Long
Secretary—Paul Mentzer, Sr.
Librarian—Al. Hirsch
Board of Managers—George Gehling, Nat. Verrelle and E. J. Zurbach, Jr.

Librarian Hirsch then conducted the question box. Due to the late hour, there was only one question: "How should one proceed to deposit 0.0005 inch copper on sheet nichrome and then gold plate over the copper?" No answer was given.

PAUL MENTZER, *Sr., Sec'y.*

NEWARK BRANCH

The regular meeting on May 3 at the Hotel Robert Treat was called to order at 8:30 P. M. with President Louis Donroe presiding. The attendance was 68 members and guests.

Five were elected to membership.

The election of officers had the following results:

President—John De Vries
First Vice President—Howard L. Cobb
Second Vice President—William Hodecker, Jr.
Secretary-Treasurer—George Wagner
Librarian—Zachary Irenas
Sargeant-at-Arms—Robert Herwig
Board of Managers—Horace H. Smith, Robert Sizelove and Louis Donroe.

Delegates to the Convention are Horace H. Smith, George Wagner and Louis Donroe, with Edward Washburn, Solomon E. Barr and John Guthrie as Alternates.

Zachary Irenas, or new Librarian, introduced the guest speaker, Mr. H. Leroy Beaver. His subject was "Barrel Burnishing", a very good subject in which most of the platers are interested. Numerous questions were asked, mostly pertaining to burnishing materials and compounds. In his answers, Mr. Beaver pointed out that barrel burnishing was started with pebbles, crushed stone, etc., which were gradually replaced, first with steel balls, and then with all shapes of steel burnishing material, each one having its own particular value.

GEORGE WAGNER, *Secretary*

COLUMBUS BRANCH

The April 26 meeting at the Battelle Memorial Auditorium was called to order by Librarian Thomas Lavery.

It was agreed unanimously that no display be presented by this Branch at the National Convention since there is no material in this area which would fit into the general scheme.

A lengthy discussion concerning membership was held. It was decided that some of the future meetings would be held in neighboring cities in order to promote membership and attendance.

Program improvements included the following:

Speakers on interesting subjects outside the field of electroplating.

More dinner meetings with good speakers.

More dinner meetings in combination with other local societies in order to promote better programs.

The discussion of the C.T.C. was led by Eugene Combs.

The following nominating committee was selected: Elmer A. Stephan (Chairman), Waldemar P. Ruemmler, Burt E. Friedl, H. Harold Bulkowski and Paul D. Miller.

Refreshments were served following the meeting.

DAVID S. STOKER, *Secretary*

COLUMBUS BRANCH

The March meeting featured Mr. Gordon J. Berry, Vice President and Sales Manager

of the Electric Products Company of Cleveland, Ohio. Mr. Berry presented a paper on "Comparative Operating Characteristics of Motor Generators and Rectifiers", supplemented with slides which showed in detail the comparative costs to the metal finishing industry of the two methods of generating direct current. A question and answer session followed.

An interesting letter was read from Jesse V. Parker who has recently moved to Albuquerque, New Mexico, where he and associates have formed the Mile-High Manufacturing and Plating Co. This company is unique in that it has the only plating shop in the State of New Mexico.

DAVID S. STOKER, *Sec'y.*

LETTER FROM ADELAIDE BRANCH PRESIDENT

WE are pleased to print the following letter to F. Bunker, Secretary of the Los Angeles Branch. It is dated January 24, 1946.

Dear Mr. Bunker:

During the war years, I have had little opportunity to correspond with the Branch; however, I have been receiving THE REVIEW and have followed the Branch News with interest.

You will no doubt have read of a new Branch having been formed in Adelaide, Australia, just recently. I was honoured at being elected its President and it is my desire that the Los Angeles Branch arrange for my transfer to Adelaide. Several other old A.E.S. members here have also joined the new Branch.

As it has not been possible to forward dollars to U.S.A. from Australia during the war years owing to Government control, I have not paid any dues to the Branch for sometime. As the position has eased, I would be pleased if you could forward me an account for outstanding dues so that I may bring such up to date. Several members from Australia visited A.E.S. meetings during the last year and were high in their praise for the manner in which they are carried out.

During the war, Australians were able to see a good deal of your boys out here and were very impressed with their good nature and friendliness — the best ambassadors any country could send to Australia.

In conclusion, please extend to your members the good wishes of the Adelaide Branch. We would be pleased to exchange with you papers presented at your meetings, and trust that in this way our two Branches may be drawn closer together.

Thanking you for past services,

Yours faithfully,
W. P. BLANCH

STREAM POLLUTION

(*Continued from page* 606)

6. *Reduction of concentrations of metallic compounds* below limits toxic to fish and animal life.

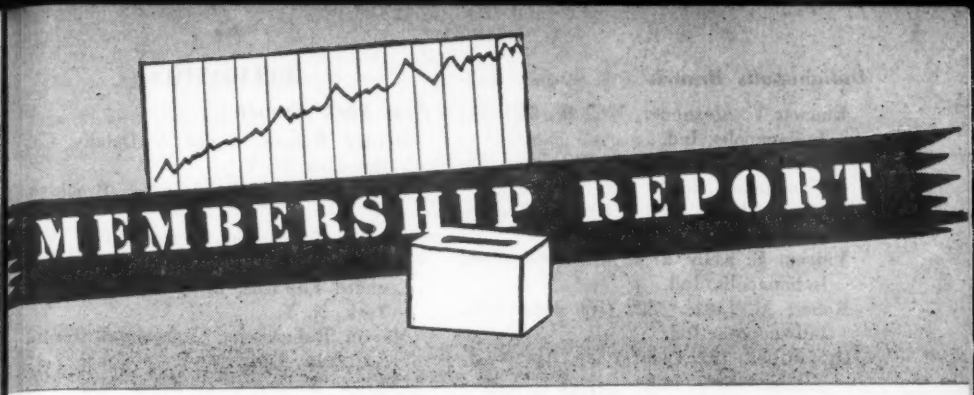
Conclusion.

This article was prepared with the purpose in view of summarizing the present status of the industry's waste problem. In addition to personal experiences, much reference material was incorporated for which acknowledgment is made.

It has been shown that a number of factors enter into the development of a sound plan of control. Waste handling is not a simple matter. There is no magic cure-all for the waste problem any more than there is for any production problem. Yet industry has made an excellent production record while its record of pollution control leaves much to be desired. The difference in accomplishment lies in the fact that knowledge and ability has been applied to the former while the latter has received only superficial interest. Research has provided the principles by which correction can be made and large scale experience offers additional guidance. It devolves upon industry to develop these principles into full scale application, suitable for its particular operations.

Du Pont Pittsburgh Office in New Location

E. I. du Pont de Nemours and Company, Grasselli Chemicals Department, recently announced the removal of their office to 514 Park Building, 351 Fifth Avenue, Pittsburgh 22, Pa., telephone, Grant 5427. C. E. Leonard, Jr. is manager of this office.



RAYMOND J. O'CONNOR
Chairman, Membership Committee

ELECTIONS

Twin City Branch

John J. Harrington, Northwest Airlines, Inc., Wold-Chamberlain Field, Minneapolis, Minn.
Halick B. Johnson, 5732 Blaisdell Ave., Minneapolis, Minn.

Waterbury Branch

Martin M. Sternfels, Box 1229, Waterbury 90, Conn.
Emil L. Shaker, 22 Roseland Ave., Waterbury 41, Conn.
S. Lewis Doughty, Jr., Lea Mfg. Co., Waterbury 86, Conn.

Detroit Branch

Norman D. Hoffman, 16635 Evanston, Detroit 11, Mich.
Frank J. Lester, 734 W. Highland Dr., Dearborn, Mich.
Thomas Mahoney, 994 Madison, Detroit 7, Mich.
Ezra Mashburn, 4235 Drexel, Detroit 15, Mich.
James H. Stiles, 12671 Greenlawn, Detroit 4, Mich.

New York Branch

Carl T. Mason, 2121 Cedar Ave., New York 53, N. Y.
Arnold Havenick, 110 Kent Ave., Brooklyn, N. Y.
Nils P. Wikner, c/o Magnuson Products Corp., 50 Court St., Brooklyn 2, N. Y.
Leon Levinstein, c/o Swiss Radium & Dial Ptg. Co., 79 Seventh Ave., New York 11, N. Y.
Phillip M. Faljian, 24-25—27th St., Astoria, N. Y.
Harry Orfinger, 2136 Crotona Parkway, New York 60, N. Y.
Walter H. Prine, 613 Euston Rd., West Hampstead, N. Y.
George Berson, c/o Davis-K-Products, 114 Lexington Ave., New York 16, N. Y.

Boston Branch

Bernard T. Riley, 19½ Pleasant Street, Stoneham 80, Mass.

Toronto Branch

James L. Colby, 23 Selwood Avenue, Toronto, Canada
Thomas A. Slade, 814 Sammon Avenue, Toronto, Canada

Sydney Branch

T. O. Kolts
R. McKinnon

Los Angeles Branch

Harley J. McQuain, 4507 W. 16th St., West Los Angeles, Calif.

New Haven Branch

Eugene J. Sullivan, 1380 Dixwell Ave., Hamden 14, Conn.
G. Kenneth Willis, 147 Ardmore St., Hamden, Conn.

Buffalo Branch

Harold Lloyd Schroeder, Box 133, Williamsville 21, N. Y.

Indianapolis Branch

Emmett V. Alexander, 1062 W. 35th St., Indianapolis, Ind.
Herbert R. Clark, 4042 Winthrop, Indianapolis 5, Ind.
Frank A. Hamp, 2332 E. 65th St., Indianapolis 5, Ind.
Vincent R. Kelly, 27 E. Westfield Blvd., Indianapolis, Ind.
Robert M. Little, 3829 Graceland Ave., Indianapolis, Ind.
Otto Miller, 1321 Central Ave., Apt. No. 1, Indianapolis 2, Ind.
Raymond Doughty, Smith Valley, Johnson County, Ind.

Bridgeport Branch

Joseph W. Lewis, 728 Noble Ave., Bridgeport 8, Conn.
Frank J. Kozma, 144 Bronx Ave., Bridgeport 6, Conn.
Raymond W. Goral, 93 Waterman St., Bridgeport 7, Conn.
Joseph G. Coppola, 10 Webb Ave., Old Greenwich, Conn.

Syracuse Branch

Arthur E. Overend, 43 Myers Ave., Yorkville, N. Y.
H. R. Davis, 53 Jordan St., Skaneateles, N. Y.
Martin T. Lawlor, R.D. No. 2, Mackeyes Road, Syracuse, N. Y.
Burt J. Donaldson, c/o Easy Washing Machine Corp., Syracuse, N. Y.
Daniel Gray, Works Laboratory, Oneida, Ltd., Oneida, N. Y.

Philadelphia Branch

Lee C. Wotring, c/o Bonney Forge & Tool Works, 716 Meadow St., Allentown, Pa.
James H. Fisher, 1936 S. Galloway St., Philadelphia, Pa.
Ralph D'Stefano, 417 Commonwealth Ave., Trenton, N. J.
Harold S. Adams, 19 Washington Ave., Mt. Ephraim, N. J.

San Francisco Branch

Albert Nebe, 236 Hartford St., San Francisco 14, Calif.
Jack Powell, 774 Cayuga Ave., San Francisco, Calif.
Julian LeSire, 8434 Olive St., Oakland 3, Calif.

New York Branch

Barney Romeo, Coyne & Delany Co., Brooklyn, N. Y.
Karl Fifer, Karlite Corp., Brooklyn, N. Y.
Charles K. Hirsch, Kleer-Flo Co., New York, N. Y.
Leonard Edwards, 71 W. 45th St., New York, N. Y.
Marvin Rubenstein, Continental Record Co., New York, N. Y.
Charles Weiner, X-L Brass Mfg. Co., New York, N. Y.

Boston Branch

Saul Wolf, 125 Capen St., Dorchester 24, Mass.

Bridgeport Branch

George J. Eckholm, P. O. Box 155, Trumbull, Conn.
George W. Herbert, 81 Haseco Ave., Portchester, N. Y.
Michael Milo, 15 Charles St., Noroton Heights, Conn.
Frank Leonard, 122 N. Water St., East Portchester, Conn.
William F. Sileo, Stamford Polishing Co., Stamford, Conn.
Rocco M. Sileo, Stamford Polishing Co., Stamford, Conn.

Columbus Branch

John Edward McCarthy, 2312 N. Hight St., Columbus 2, Ohio

Newark Branch

J. LeRoy Barker, Box 643, Sparta, N. J.
William Laletin, 3374—155th St., Flushing, N. Y.

Providence-Attleboro Branch

Donald E. Grant, 37 Spring St., Plainville, Mass.
Carlton F. Granfield, 22 Cottage St., Taunton, Mass.
Coy Folcik, 763 Somerset Ave., Taunton, Mass.
J. James Kelliher, 361 Washington St., Taunton, Mass.
Thomas Marsland, 59 Emory St., Attleboro, Mass.
Frank W. Boothroyd, 6 Post Road, Pawtucket, R. I.
Thomas S. Halliwell, 833 Weeden St., Pawtucket, R. I.

REINSTATEMENTS

New Haven Branch

Robert E. Creamer

Indianapolis Branch

Leland E. Bass
Robert A. Stewart

Lancaster Branch

Ellis D. Hunter

TRANSFER

Charles Geldzahler from Philadelphia Branch to New York Branch

RESIGNATIONS

New Haven Branch

Ernest L. Andrews, Jr.
Malcolm K. Palmer

Columbus Branch

Harry M. Gould

Providence-Attleboro Branch

Roger B. Lincoln

SUSPENSIONS

Detroit Branch

A. Borland
J. A. Beers
T. K. Christianson
A. Churilla
H. K. Creese
D. Dattero
L. C. Dell
P. J. Garety
J. L. Germaine
E. W. Halstead
S. W. Hardesty
H. S. Hedburg
F. L. Koyle
G. J. Kunkel
H. A. Lassen
G. Mahfouz
E. H. McCollum
J. T. McCluskey
J. J. McMahon
K. Q. Muller
A. W. Rose
E. G. Sanders
L. E. Sherrod
E. Starkel
W. C. St. Clair

New Haven Branch

Ralph Aconfre
Albert C. Caruso
John Daley
Norman H. Eddy

Philadelphia Branch

R. E. Jackson, Jr.
G. A. Taylor

Past Presidents say Thank You

Several of the Past Presidents have acknowledged receipt of the A.E.S. buttons recently sent to them.

E. T. Candee says "I want to thank you and the Executive Committee for this pin. I have put it on and expect to wear it . . . " Charles C. Conley comments "It makes a nice appearance and is appreciated." Walter Fraine declares "The writer . . . will be proud to wear (it). The Society has grown fast . . . and its usefulness in extending our knowledge and the practice of electroplating and finishing of metals has kept pace with its growth."

George Hogaboom goes a long way when he says "My appreciation is offered for the Past President button. It is very pretty, but will necessitate that my tailor add more buttonholes in the lapel of my coat." W. M. Phillips states "It was very nice inded of the Society to send these . . . to the Past Presidents. I will be pleased to wear this button. . . . "

BOOK REVIEW

(*Continued from page* 636)

part of the book (since the type size is small and the pages well-filled, the discussion is more comprehensive than might be supposed). Many formulae for the chemical deposition of silver, gold, copper, lead sulfide, etc., are given along with rather complete working directions. More attention might have been given to spray methods for silvering because of their importance in production work.

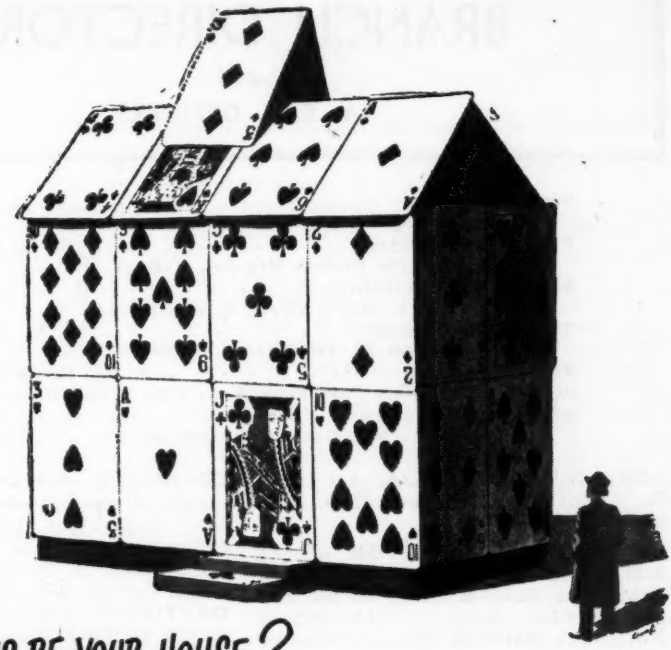
A considerable portion of the book is non-critical, and the reader may have considerable difficulty in deciding on a method for his particular purpose, but it will at least serve as a guide to various possibilities.

MEMBERSHIP CHART

BRANCH	May 1946	Change in Membership	Percent Change
FIRST GROUP			
NEW YORK	201	+ 8½	+ 4.2
BRIDGEPORT	124	+ 4	+ 3.2
WATERBURY	128	+ 3	+ 2.3
TORONTO	131	+ 2	+ 1.5
PHILADELPHIA	170	+ 1½	+ 0.9
BOSTON	168	+ 1	+ 0.6
LOS ANGELES	181	+ 1	+ 0.6
HARTFORD	134	....	....
CLEVELAND	177	....	....
NEWARK	243	....	....
CHICAGO	359	....	....
DETROIT	440	—20	— 4.5
SECOND GROUP			
INDIANAPOLIS	90	+ 9	+10.0
SYDNEY	82	+ 2	+ 2.4
BUFFALO	87	+ 1	+ 1.1
SPRINGFIELD	82	....	....
JACKSON-LANSING	85	....	....
DAYTON	87	....	....
PITTSBURGH	97	....	....
ROCHESTER	97	....	....
BALTIMORE-WASH.	114	....	....
GRAND RAPIDS	116	....	....
MILWAUKEE	120	....	....
ST. LOUIS	122	....	....
PROV.-ATTLEBORO	122	— 1	— 0.8
NEW HAVEN	110	— 3	— 2.7
THIRD GROUP			
SYRACUSE	64	+ 5	+ 7.8
SAN FRANCISCO	64	+ 3	+ 4.7
TWIN CITY	72	+ 2	+ 2.8
LANCASTER	38	+ 1	+ 2.6
ADELAIDE	37	....	....
ROCKFORD	53	....	....
CINCINNATI	58	....	....
MELBOURNE	59	....	....
ST. JOSEPH VALLEY	60	....	....
TOLEDO	60	....	....
MONTREAL	61	....	....
COLUMBUS	34	— 1	— 2.9

Membership May 1, 1946 = 4,527
Membership June 1, 1946 = 4,546

Gain in Membership = 19
Per Cent of Gain = 0.4



COULD THIS BE YOUR HOUSE?

Now that the war's over and a lot more civilian goods are on the market, it's a big temptation to spend just about all you make, and not put anything aside.

But to fall for that temptation is plenty dangerous. It's like trying to live in the house above—a house that might come tumbling down about your ears at the first little blow of hard luck.

Right now the best possible way to keep your finances in sound shape is to save regularly—*by buying U. S. Savings Bonds through the Payroll Plan.*

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MONTHLY REVIEW

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(*Continued on next page*)

BRANCH DIRECTORY

(Continued from preceding page)

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INDEX TO ADVERTISERS

A

Alsop Engineering Corp. 588

B

Bacon Felt Company 589
Baker Company, M. E. 645
Blakeslee & Co., G. S. 650
Burns Mfg. Corp., E. Reed 658

C

Ceilcote Company, The 659
Columbia Electric Mfg. Co. 651
Cowles Detergent Co. 590
Crane Equipment & Supply Co. 657

D

Darco Corporation 600
Divine Brothers 660
Du Pont de Nemours & Co., Inc. 584-585

E

Egyptian Lacquer Mfg. Co. 592

G

General Chemical Co. 619
General Electric Co. 595
Gumm Chemical Co., Fred'k 2nd Cover

H

Hanson-Van Winkle-Munning Co. 630-631
Harrison & Company 652
Harshaw Chemical Co., The 596
Hay Company, Jacob 657
Heatbath Corporation 597

I

Industrial Filter & Pump Co. 593
Industrial Lining Eng., Inc. 648
Industrial Timer Corp. 649

K

Kirk & Blum Mfg. Co. 658
Kocour Company 647

L

Lasalco, Inc. 598
Lea Mfg. Company ..... Back Cover
L'Hommedieu & Sons Co. 594

M

Maas & Waldstein Co. 599
MacDermid, Inc. ..... 3rd Cover
Magnus Chemical Co. 637
Magnuson Products Corp. 660
McGean Chemical Co. 591
Meaker Company, The 654
Michigan Bleach Co. 616
Michigan Buff Company 659

N

Nankervis Company 608

O

Oakite Products, Inc. 583
Optimus Equipment Co. 613

P

Packer Machine Co. 612
Promat Div., Poor & Co. 678
Puritan Mfg. Co., The 614

R

Richardson-Allen Corp. 653

S

Seeley Company, E. E. 655
Sparkler Mfg. Co. 615
Stevens Co., Prederic B. 586
Storts Welding Company 662
Sulphur Products Co. 646

U

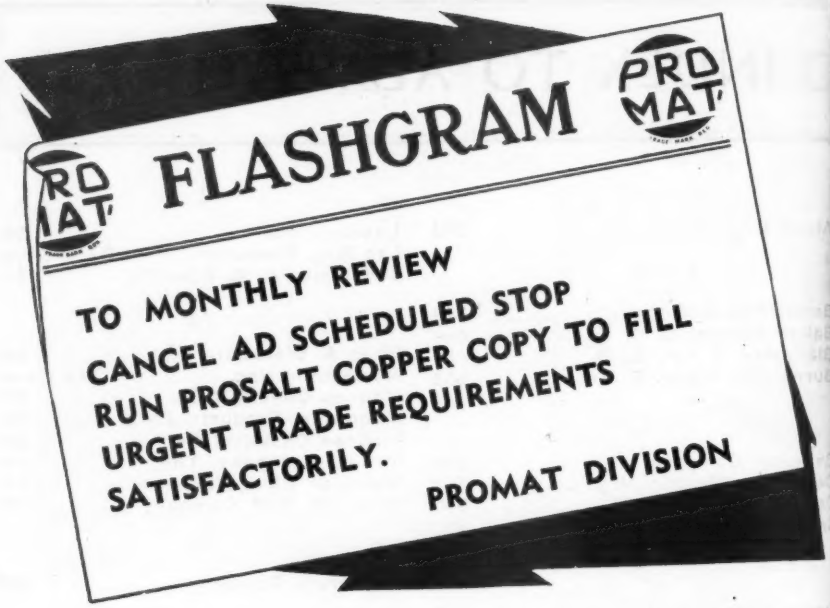
Udylite Corporation 676
U. S. Stoneware Co. 607

W

Wyandotte Chemical Corp. 643

Z

Zapon Div., Atlas Powder Co. 618



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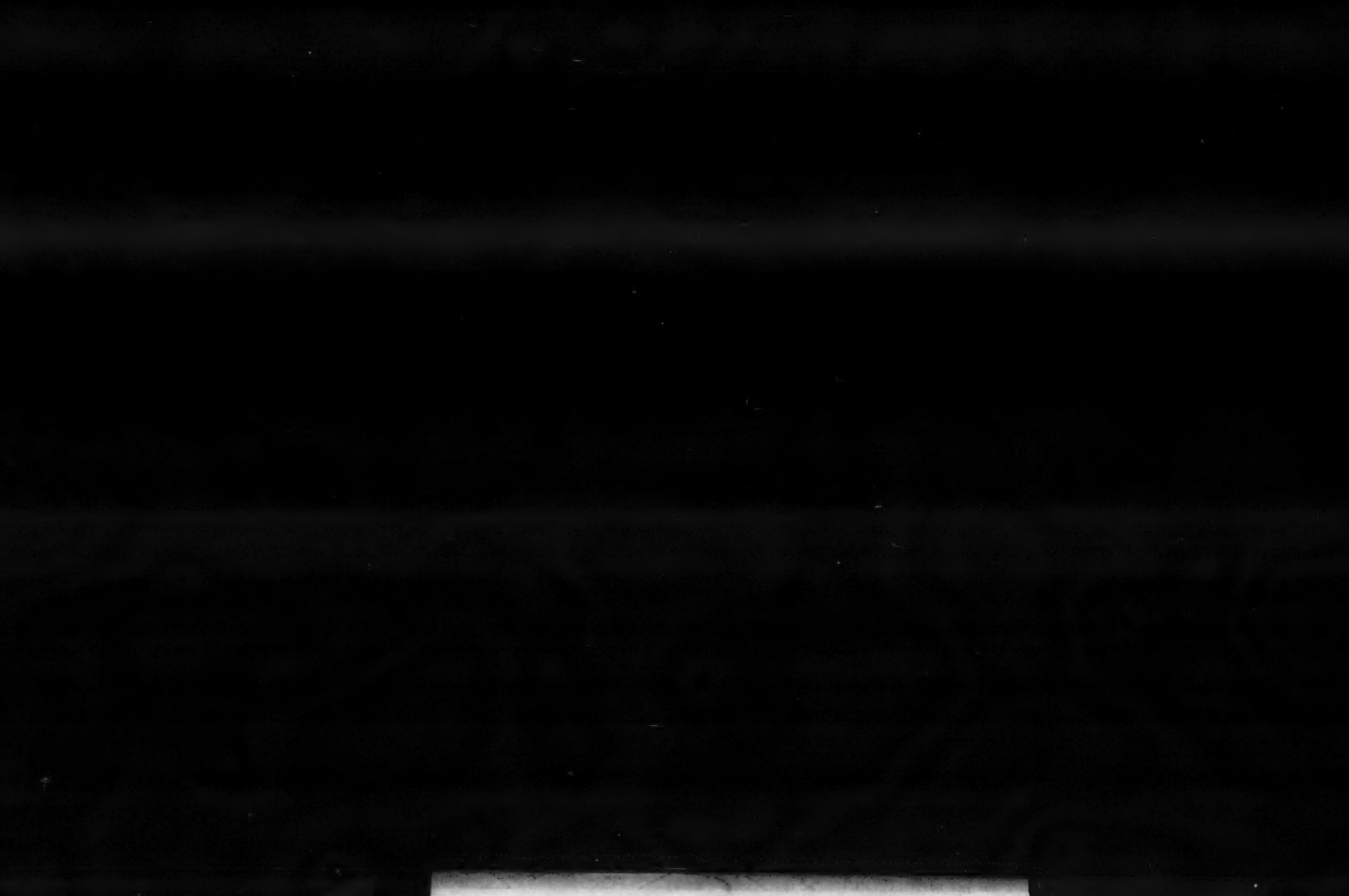
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